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A GEOGRAPHY OF CEYLON FOR SCHOOLS

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A GEOGRAPHY OF CEYLON

FOR SCHOOLS

BY

A. DOUGLAS BAPTIST, B.A., Dipl. Geog. (Lond.)

Author of

'A Junior Geography'

'Contour & Mapping Exercises'

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PREFACE

THIS book is intended for use in the upper classes of Ceylon Schools. It would most profitably be used as a sequel to the author's 'A Junior Geography for Ceylon Schools.' An attempt has been made to touch upon such matters in elementary physical and general geography as had been unavoidably omitted in the earlier book. As a book for the general reader, however, it is hoped that the inclusion of such topics as structure and relief, soils and irrigation, climate and agriculture within the covers of a single volume will meet a long felt need. The chapters on such topics have been read in manuscript by various specialists, who have given me the benefit of their advice in their respective fields. Their criticisms have been helpful in preserving this work from mis-statements and erroneous judgements. For the plan and scope of the book, however, and for such errors as still remain, the author assumes full responsibility.

My very special thanks are due to Mr. L. J. D. Fernando, Government Mineralogist, Dr. A. W. R. Joachim, Director of Agriculture, Mr. R. D. Kreltszheim, Assistant Director of Meteorology, Mr. E. J. Livera, Lecturer in Agriculture at the University of Ceylon, Dr. B. A. Baptist of the Tea Research Institute, Mr. E. R. A. de Zylva, Deputy Director of Fisheries, and Mr. L. S. de Silva of the Colombo Port Commission.

I have also freely availed myself of the help of a number of friends and teachers of geography in the schools. In particular, I have to thank Mr. S. D. V. Perera of Kingswood College, Mr. W. D. E. Perera of Nalanda Vidyalaya, and Mr. J. E. N. Phoebus of S. Peter's College for their very useful suggestions. I must also thank Mr. Parakrama Abayawardana for help in the preparation of many of the maps

and diagrams, and all my other friends, who so kindly supplied photographs and helped in more than one way to lighten my task.

In conclusion, I wish to express the hope that teachers and others who use the book will not withhold from me any criticisms and suggestions that they may feel constrained to make.

April, 1955. A. D. BAPTIST.

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A GEOGRAPHY OF CEYLON

CHAPTER 1

INTRODUCTORY

Ceylon is a pear-shaped island occupying a fairly central position in the Indian Ocean, and separated from South India by Palk Strait and the Gulf of Mannar. The shortest crossing is afforded by the steamer connection plying north of Adam's Bridge between Talaimannar on the Island of Mannar and Dhanushkodi on Pamban Island, both of which are connected by bridges with their respective mainlands. The Adam's Bridge shallows prevent direct ocean communication between the Gulf of Mannar and Palk Strait, but a drawbridge between Pamban Island and the Indian mainland permits the use of the Pamban channel by vessels of shallow draught plying along the Coromandel coast.

The Island has an area of 25,332 square miles, of which 25,036 square miles or roughly 16,000,000 acres are land, the rest being inland water. The Island is nearly twice as long as it is broad, Point Palmyra—which is two miles to the west of Point Pedro—being 270 miles from Dondra Head as the crow flies; and Sangamankanda Point—9 miles north of Pottuvil—being 140 miles from Colombo by the same method of reckoning. Ceylon lies entirely between the parallels of latitude 5° 54′ and 9° 52′ N. and between the meridians 79° 39′ and 81° 53′ E.

The position of Ceylon at the intersection of ocean routes in the Indian Ocean, and also on the Suez route from Europe to the Far East and Australia, has not only enhanced its commercial importance, but has also acted

as an antidote against insularity of outlook, and has helped to give its inhabitants a more cosmopolitan and progressive outlook than would be found in remoter parts. Its position in relation to the Indian sub-continent has been sufficiently close for it to benefit from cultural contacts with its great neighbour. Its languages, religions and art have all been

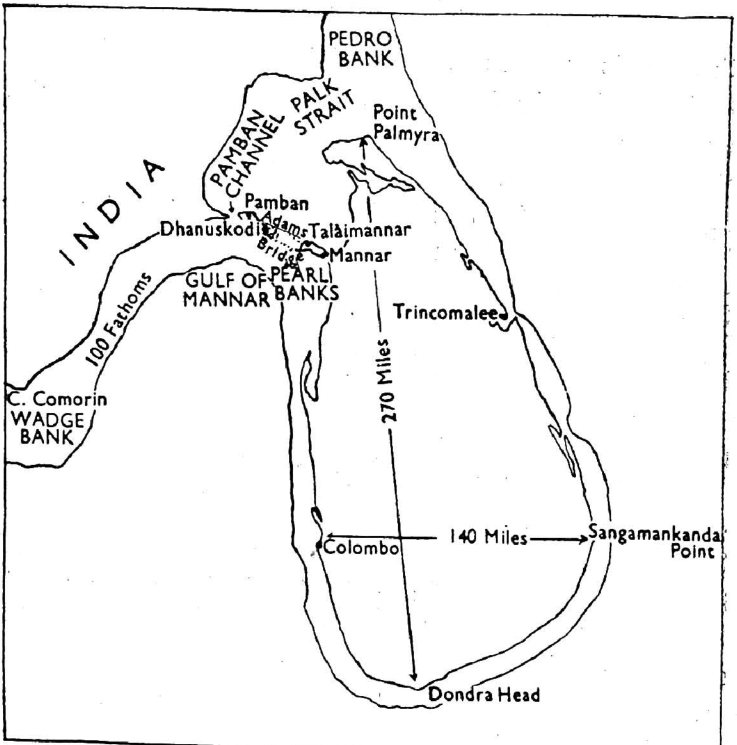


FIG. 1.—Ceylon: Position in relation to India.

derived from the neighbouring sub-continent, but its island nature has checked the intensity of cultural change and enabled it to preserve its individuality from being swamped by its more powerful neighbour. Thus the Island has retained the Buddhist religion which has practically disappeared from India, its original home.

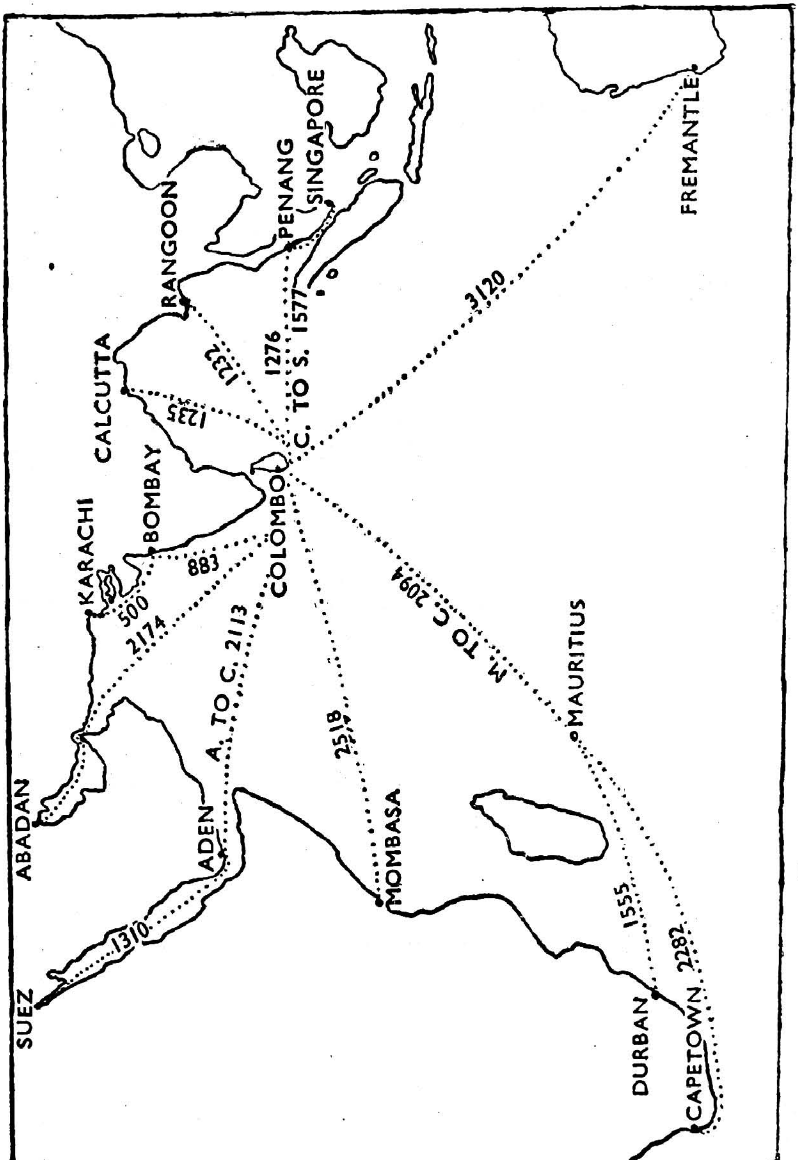


FIG. 2.—Position of Ceylon in Indian Ocean.
(Distances in nautical miles.)

The northern plain of Ceylon, though arid, is somewhat better watered than the opposing Indian coast, and has from the earliest times attracted the attention of the Tamils of the Carnatic plain. The Tamil invasions were the chief features of Ceylon's early history. The neglect and ultimate abandonment of the tank country were due to these invasions. At the present day, the north and east are predominantly settled by Tamils, who are descendants of these early invaders.

Even before the tenth century Arab traders had established themselves peacefully on the coast of India. It is not certain when they actually reached Ceylon, but it is on record that an entire colony landed at Beruwala in A.D. 1024. Direct trade between Arabia and Ceylon brought other Arabs too, who made settlements at other points on the coast, such as Hambantota, Pottuvil, Kattankudi and Puttalam, from where they infiltrated throughout the country, inter-marrying with the inhabitants, and even adopting their language, but not swerving from their religion.

With the discovery of the Cape route to India, attempts were made by the commercial nations of Europe to establish trading posts along the coast. The first Europeans to arrive were the Portuguese (1505), who remained in Ceylon for a century and a half. Their supremacy, however, was restricted to the coastal districts. Under their influence the growth of cinnamon, pepper and arecanut was encouraged, and some new crops introduced such as chillie and tobacco. The spread of the Roman Catholic religion is perhaps their major contribution to the life of the people, and other vestiges of their occupation are seen in the Portuguese surnames still retained by large numbers of low-country Sinhalese, and in the names of a number of articles in common use.

The Dutch (1658-1798) who succeeded the Portuguese

were also unable to extend their domination into the hill-country. They were more intent on trade and the pursuit of wealth than the Portuguese. They fostered agriculture, set up plantations, and introduced new crops. They built canals and roads, and constructed a number of forts which are still extant. Their main contribution, however, was the introduction of Roman-Dutch law into this country. They have also made two contributions to the population: (1) The Burghers, who are the descendants of the Dutch merchants, and subsequently took up employment under the British, and (2) the Malays, whose ancestors were brought by the Dutch from Java either for military service, or as political deportees.

Under the British the whole Island came for the first time under a single unified administration, and a feudal system of government was succeeded by that of a modern bureaucratic state. Though viewed with disfavour by the hereditary chiefs and the Buddhist priesthood, the British system of government effected innumerable improvements in the lives and condition of the mass of the people. The British introduced a uniform legal system, opened up plantations in the wet zone, for which they imported South Indian labourers, built roads, bridges and towns, repaired the irrigation works in the dry zone, established schools, provided medical aid to the villagers and tried to ameliorate their condition in many ways. Most important of all they secured for Ceylon freedom from foreign invasion for well over one and a half centuries. By encouraging the spread of western liberal ideas during this period they attempted to educate the people to a new sense of nationhood—that of the Ceylonese nation. By the grant of universal franchise they bestowed power on a new race of politicians drawn from the middle classes, and finally left them, perhaps too precipitately, as rulers of the smallest and youngest Dominion of the British Commonwealth.

The new dominion, however, does not face the future quite alone. Under the Defence Agreement corollary of the Ceylon Independence Act of 1947, the United Kingdom agreed to provide Ceylon with such military assistance as she may from time to time require, and in return, Ceylon has granted the United Kingdom control of the naval base of Trincomalee, and promised to provide further naval, military and air bases as the latter may require.

EXERCISES

1. Between what two points is the shortest ferry connection between Ceylon and India? Determine its distance by reference to the motor map of Ceylon.

2. Describe the position, dimensions and area of Ceylon. To what extent has geographical position influenced the development of the Island and its peoples?

3. Summarise the influence of (*a*) the Portuguese, (*b*) the Dutch, (*c*) the British on the development of Ceylon.

4. Examine the significance of Ceylon's position with reference to (*a*) India, (*b*) the World.

CHAPTER 2

STRUCTURE AND PHYSICAL HISTORY

The science which investigates the history and structure of the earth is known as *geology.* The study of geology has shown us that much of what is dry land today has at some time or other been under water as ocean or sea, and that the age of the earth goes back to a much greater antiquity than our great-grand-parents ever supposed.

Sedimentary rocks are those which originated as sediments generally on the floors of shallow seas or ocean borders. They grew by the accumulation of film upon film of sediment gently settling down upon the sea-floor, and ultimately the bottom-most sediments grew hard and compact by the weight and pressure of subsequent sediments laid over them. Finally, however, earth-movements may conspire to raise the sea floor in parts, and convert it into dry land.

From the geological point of view, Ceylon consists of the oldest known rocks and the youngest. It has been possible to determine the relative ages of rocks from a study of the fossils (i.e. animal and plant remains) found buried in the sedimentary rocks in regions which have not undergone deformation or disturbance. The older rocks contain the remains of earlier and more primitive forms of life now extinct, while modern and present day forms are only found buried in the younger sedimentaries.

The sedimentary rocks, originally built up by sediments deposited in horizontal layers or beds, are often tilted out of the horizontal by subsequent earth movements. When such layers are eroded or fractured, the broken edge may outcrop, i.e. lie exposed at the surface,

and may form asymmetrical ridges called *cuestas*, with a gentle slope in the direction of the dipping layer on one side (dip-slope) and a steep slope (scarp-slope or escarpment) on the other. It is usually the hard layers that form cuestas, the softer outcrops, being more susceptible to erosion, form depressions or valleys. This alternation of scarp and vale gives rise to what is called scarpland topography.

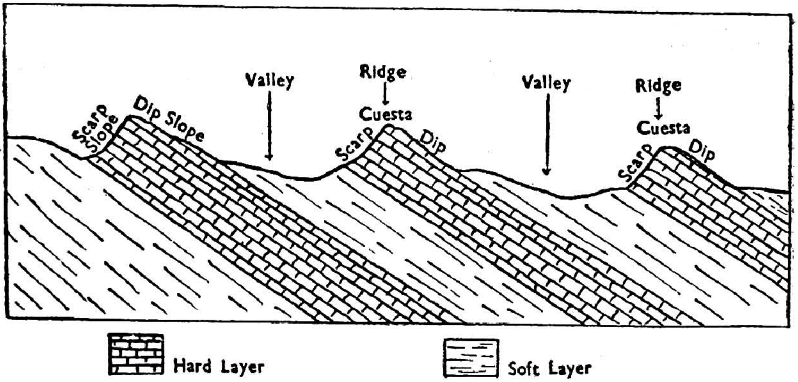


FIG. 3.—Section through a region of scarpland topography.

The direction of greatest slope of an inclined bed is called the *dip*. A line at right angles to the dip and running

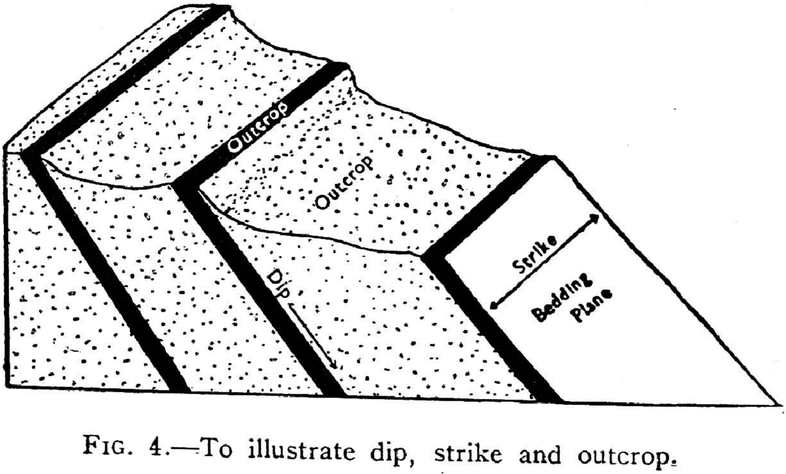


FIG. 4.—To illustrate dip, strike and outcrop.

along the *bedding plane* or surface of the bed is called the *strike*—a word related to 'stretch', the strike indicating the direction in which the outcrop runs.

When beds are bent into a series of folds, the arches of the folds are called *anticlines*, and the troughs *synclines*.

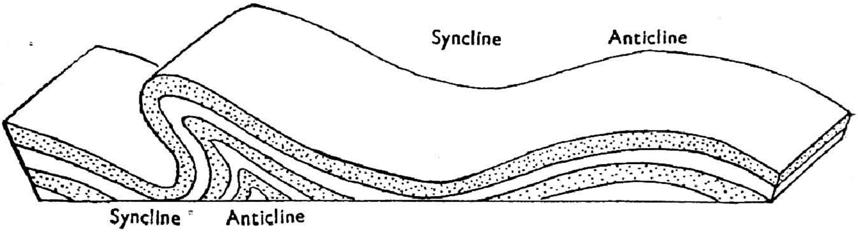


FIG. 5.—Folded beds.

Sometimes there may be smaller puckers and folds within a major syncline or anticline. Such a complex

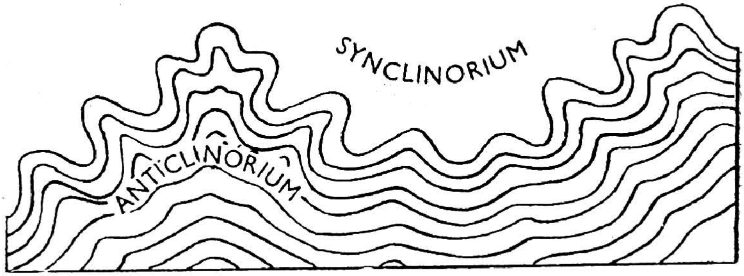


FIG. 6.—Schematic section across an anticlinorium and synclinorium.

syncline is known as a *synclinorium*, and a complex of anticlines as an anticlinorium.

If you examine the geological map of the world in your atlas you will find from the key to the map that the rocks are arranged in a column in order of superposition, the oldest rocks being placed at the bottom of the column, and the youngest at the top. All the rock systems forming the column may be divided into four main groups or eras: Archaean, Primary, Secondary and Tertiary. The Archaean or Pre-Cambrian rocks, which date from over 500 million years to about 2,000 million years ago, are well represented in Ceylon by the gneisses, which form the framework and core of the Island. These are subdivided into two main groups:

(*a*) The fundamental gneisses are composed of metamorphosed igneous rocks, and are often referred to as the Vijayan series. They form the fundamental ground-rock or basement of Ceylon.

(*b*) Above these lie a thick series of highly metamorphosed sediments called the Khondalites. These include the crystalline limestones and the quartzites of the Central Hill-Country. They contain the chief mineral deposits of Ceylon—graphite and gems. As is to be expected from their highly metamorphosed nature, these rocks contain no direct fossil evidence of life. Such forms of life as existed were probably soft-bodied, and did not contain hard bones or shells that could stand preservation.

Intrusive into (*a*) and (*b*) in certain parts are the igneous rocks of Ceylon, the granites and the charnockites.

The rocks of the Primary group which covers a period of 200 to 500 million years ago are entirely absent from Ceylon.

Of the Secondary group which covers a period of 70 to 200 million years, we have two very small pockets of

Jurassic rocks, one at Tabbowa near Puttalam, and the other at Andigama, some 25 miles south of Tabbowa. These are fresh-water beds of sandstone and hardened clay (shale), the latter containing fossils of plant impressions. The Jurassic period which has been named after the Jura Mountains of Europe, where rocks of this system are well developed, is often referred to as the Age of Reptiles, as the fossils found in these rocks show that reptile life was very abundant and varied during this period.

Of the various rock systems that go to form the Tertiary group, which covers a period of time from 1 to 70 million years ago, the chief representatives in Ceylon are the limestones of Jaffna, which belong to the Miocene rock system. The Jaffna limestone is a hard compact rock of a creamy or greyish colour. In some places it is covered by thin layers of grey soil, and in others by red soil, both of which are products of its own decomposition. These Miocene rocks cover the north-western portion of the Island, extending from the north of the Kalpitiya peninsula to about 12 miles north of Mullaittivu on the east coast. At the margins of the Jaffna Peninsula the limestone beds are overlain by coral of more recent age. The great mountain building movements responsible for the formation of the Alps, Himalayas and other young-fold mountain systems of the world took place mainly during the Miocene period.

Lastly, at the very top of the geological column comes the rock system known as the Pleistocene, which together with the sands and silts laid down at the present day, are grouped by some authorities to mark the beginning of a new era, the Quaternary. The remains of prehistoric man throughout the world occur only in the Pleistocene and subsequent deposits.

The following is the table of rock systems. It is given here for convenient reference.

THE GEOLOGICAL TABLE

Group or Era	Earth Movements	Rock System or Period	Age in millions of years	Distinctive Life Forms	Ceylon Equivalents
Quaternary		Recent and Pleistocene	1	Man	
Tertiary		Pliocene			
	Alpine	Miocene			Jaffna limestone
		Oligocene			
		Eocene	70	Mammals and Flowering Plants	
Secondary		Cretaceous			
		Jurassic		Reptiles	Tabbowa beds
		Triassic	200		
Primary	Hercynian	Permian		Amphibians and Primitive plants	
		Carboniferous			
	Caledonian	Devonian		Fishes	
		Silurian			
		Ordovician		All classes of	
		Cambrian	500	Invertebrates	
Archaean		Upper Pre-Cambrian		Scanty remains of Sponges and Seaweeds	Khondalites of the Central Highlands
		Lower Pre-Cambrian	2,000	No direct fossil evidence of life	Vijayan Series of Eastern and S. W. Ceylon

Physical History

From the end of Pre-Cambrian times, Ceylon has been part of a continental land mass, and has never since been entirely below sea-level. From the time that it first emerged from the Pre-Cambrian seas, a very great thickness of crystalline rock has been removed by erosion. Long ages of continued denudation reduced the whole Island to

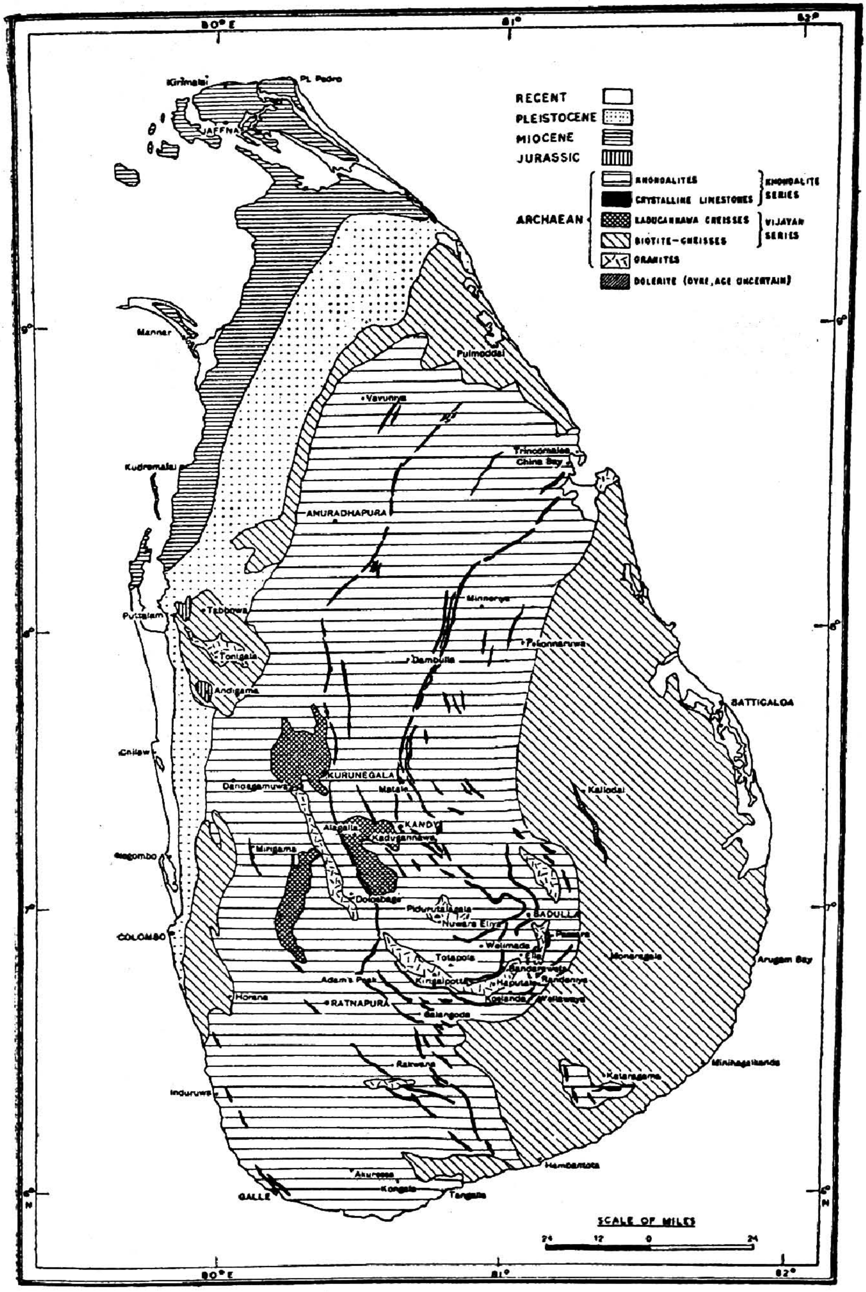


FIG. 7.—Geological Map of Ceylon (after L. J. D. Fernando). (*Reproduced by kind permission of the Government Mineralogist*).

a peneplain of low elevation about the height of the present coastal plain. The Island remained in the quiescent stage till the end of the Jurassic period, during which the Tabbowa beds were laid down.

At the end of the Jurassic a series of movements took place resulting in the regional uplift of the central parts of the Island to form the Central Highlands. Then followed a period of quiescence till the end of the Oligocene period. Denudation during this second period of quiescence resulted in the formation of a second peneplain of which the Kandy Balangoda and Bibile plateaus are remnants.

Just before the Miocene period the central-most parts of the highlands were subjected to a further series of upthrusts resulting in the formation of the Pidurutalagala-Totupola ridges, and the southern mountain wall—Adam's Peak to Namunukula. Sufficient time has not elapsed since these movements for the work of peneplanation to have proceeded far, but the summits of these are referred to as the third peneplain, which was the last to be formed. The numerous waterfalls found in it and its deeply dissected nature are evidence of the recency of its uplift.

Simultaneously with this uplift, the north-western parts of the Island were depressed below sea-level, thus severing Ceylon from the Deccan plateau and making it a separate geographical entity. A wide arm of the sea flooded the mainland between Madras and Vavuniya, and in it the Miocene limestone beds of Jaffna were laid down. Since the end of Miocene times, however, there has been a slow upward movement of the sea-bottom, converting the marginal portions of these beds to dry land between Jaffna and Kalpitiya. Evidence of recent uplift is also found further south on the west coast, e.g. at Hikkaduwa, where a buried coral reef lies several yards inland from the

seashore, and is being dug up as a source of lime for making chunam.[1]

Structurally, the Island is a synclinorium of fundamental gneisses, which outcrop widely at the surface in the eastern half of the Island, and more narrowly in the west. The long axis of the synclinorium is from S.S.W. to N.N.E. The gneisses of both east and west thus dip towards the centre. The axis of the synclinorium is not horizontal but has been thrown upwards in the south, so that it has a pronounced pitch to the north, where it plunges underneath, and is overlaid by Miocene and more recent deposits. The Khondalites which are themselves much folded, bedded and jointed, occur within the synclinorium and form the main mass of the Hill Country, whose highest summits are, however, granitic intrusions, now exposed by denudation.

Crystalline rocks like gneiss and granite consist of a mixture of crystals of various substances. Of these the commonest is quartz. Quartz is a crystalline form of silica, SiO_2, which is a compound of oxygen and silicon, the two commonest elements of the earth's crust. The formula SiO_2 is a simple way of expressing the fact that every atom of silicon in quartz is combined with two atoms of oxygen. Oxygen is by far the most abundant element found in rocks. In combination with other elements it

[1] The above is D. N. Wadia's reconstruction of the geological history of the Island. (See Records of the Department of Mineralogy, Professional Paper No. 1, 1943.) An earlier explanation, outlined by Adams, a Canadian geologist, who visited Ceylon in 1928, was that the Island was subjected to successive uplifts *en masse*, and not to partial block uplifts. According to this view, the present coastal plain was the last surface to emerge above sea-level, and the summits of the Central Highlands the first. More recently, K. Kularatnam of the University of Ceylon has expressed the view that this concept of the three peneplains is an over-simplification of the actual structure. He finds considerably more than three peneplained surfaces, and attributes their great number to the disruption of the Central Highlands 'into a multitude of faulted blocks and splinters, with some tilting of the surfaces'.—See Presidential Address to Section D of the Ninth Annual Session of the Ceylon Association for the Advancement of Science, Colombo, 1954.

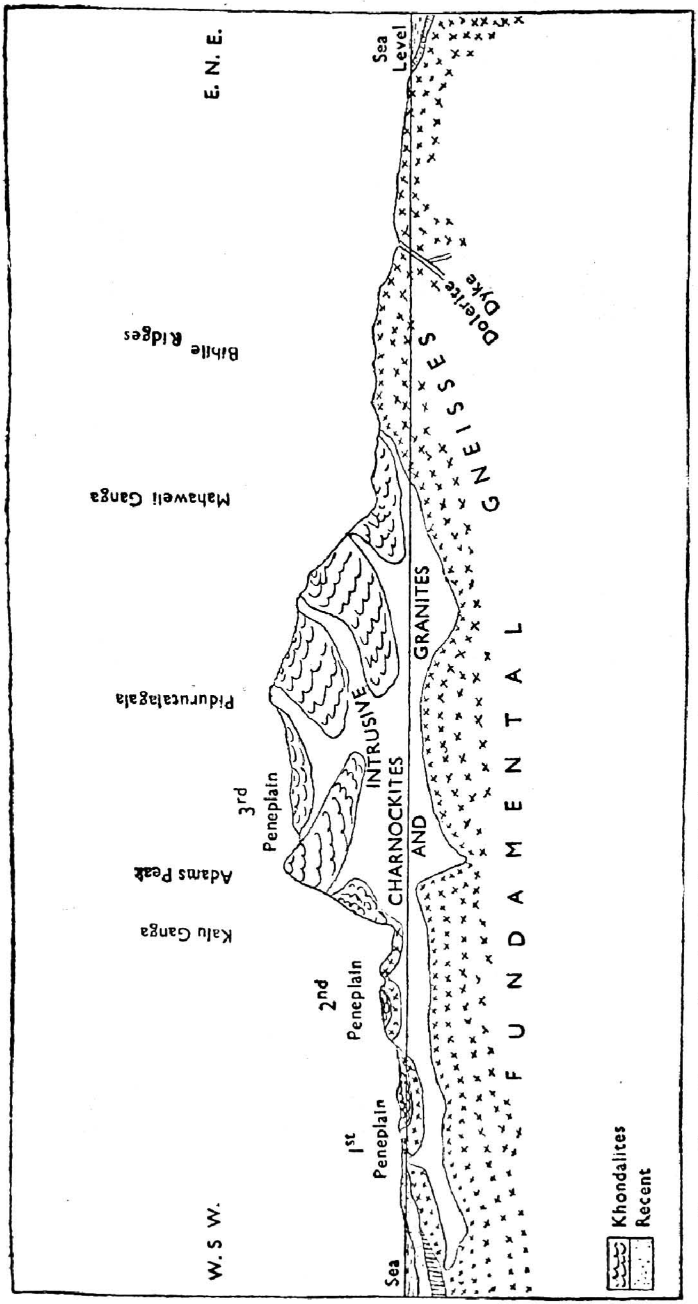


FIG. 8.—Generalised Geological Section across Ceylon from W.S.W. to E.S.E. (After D. N. Wadia). Vertical scale greatly exaggerated. (*Reproduced by kind permission of the Government Mineralogist*).

forms oxides, and as silicon is the second most abundant element after oxygen, it is not surprising that the oxide of silicon, SiO_2, should be the most abundant of all the oxides. Other oxide minerals are the iron oxides, which may also be present. The other common components of the crystalline rocks are felspar and mica. Felspar is creamy white or pink in colour. Unlike quartz, which has a glassy appearance and is extremely hard, felspar is softer and extremely liable to decomposition, especially under tropical conditions of heat and moisture. One of the commonest products of the decomposition of felspar is kaolin, the chief ingredient of porcelain manufacture.

There are two leading varieties of mica, white and black, the latter being commoner and being responsible for the dark colour of gneiss and granite. In combination with white felspar it gives these rocks their characteristic grey colour. Mica has the property of splitting into extremely fine glassy flakes which are both flexible and elastic. When it occurs in veins, as in some parts of the Kandy and Matale districts, it is possible to get sheets of mica large enough to be used in furnace windows. Its high resistance to heat and electricity makes it second only to copper in its usefulness to the electrical industry, where it is much in demand as insulating material, and for making heating apparatus, in which the heating elements are coiled round the mica, which remains unaffected by the heat. It is also greatly in demand for use in radios and automobile and aeroplane engines.

Joints

Many compact rocks whether igneous or sedimentary often exhibit 'joints', or a tendency to split along certain directions rather than others. These may be along bedding planes, but often rocks will also split along two sets of planes at right angles to the bedding. These planes of

weakness may be due to shrinkage after formation; in the igneous rocks during cooling, and in the sediments during drying. The cracks seen on a dried-up pool of mud are an example of the latter. Very often joints are due to strains set up by earth-movements. A rock or crag exposed to the heat of the sun by day, and cooling and contracting by night, is also subject to great strains, and will therefore develop joints. Joints may be defined as fractures at which only a little movement, and that at right angles to the fracture plane, has taken place. They exert a considerable influence on the form of rocks and crags exposed to the weather.

EXERCISES

1. What are sedimentary rocks? How are their relative ages determined?
2. What are the chief constituents of the crystalline rocks of Ceylon?
3. Describe briefly the structure and build of the Island.
4. What evidence have we of slow changes of level on the coasts of Ceylon?
5. Define: outcrop, dip, strike, anticline, cuesta, bedding plane, joint.
6. Write explanatory notes on: Primary Group, Secondary Group, Tertiary Group. What representatives of these groups are found in Ceylon?

CHAPTER 3

RELIEF

On the basis of relief the Island falls into two regions:

(1) The coastal lowlands, widest in the north and narrowest in the south-west.

(2) The central highlands.

The coastal plain varies in height from sea-level to about 500 feet, and comprises three-fourths of the area of the Island. It is a much denuded peneplain whose hollows have been filled with alluvial deposits, but whose rocky floor emerges here and there in a few hills which represent remnants of erosion. Some of the more resistant of these reach well over 1,000 feet in height, e.g. Kataragama 1,390 feet, Westminster Abbey 1,831 feet, Friar's Hood (Walimbe) 2,159 feet, Gunner's Quoin 1,753 feet.

In the piedmont zone bordering the hill country proper are a number of prominent peaks like Batgala (Bible Rock) 2,618 feet, Moneragala Hill 3,646 feet, Dambulla Rock, Sigiriya 1,193 feet, Ritigala 2,514 feet, Galgiriya ridge some twelve miles to the north-east of Maho, and the Animal Rocks of Kurunegala. These, too, are of the nature of residual hills.

The central highlands fall into three portions:

(1) The Central Plateau proper.

(2) The Knuckles Hills to the north-east.

(3) The South-Western Ridges and Rakwana Hills.

The Central Plateau rises in two terraces above the coastal plain, the first terrace being formed by the Kandy and Balangoda plateaus, which have an average elevation of about 1,700 feet. Rising from the first terrace and con-

taining the highest summits and ridges is a second terrace at a general altitude of about 4,000 feet.. The highest parts of this terrace are arranged in plan in the shape of an anchor, and consist of (1) The Pidurutalagala ridges, (2) The High Plains and peaks, (3) The Southern Mountain Wall.

The High Plains and the Pidurutalagala ridges form the shank of the anchor (see Fig. 9) consisting of Nuwara Eliya, Moon Plains, Elk Plains, and Horton Plains, Pidurutalagala, 8,281 feet, Kirigalpota 7,857 feet, and Totupola 7,741 feet. The High Plains descend by bold scarps to the south, west and east, the rivers crossing their edges in falls, Ramboda and Elgin Falls on the west, and Kurundu Oya and Parawella

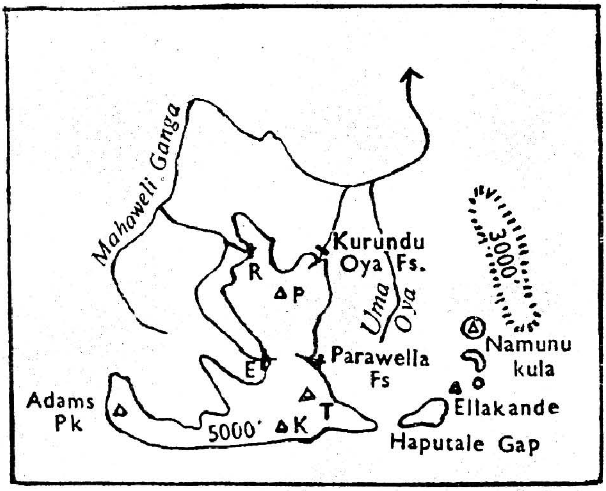


FIG. 9.—The Second Terrace.
R=Ramboda Falls. E=Elgin Falls. P=Pidurutalagala. T=Totupola. K=Kirigalpota.

Falls on the east. The scarp face to the south, however, is perhaps the most striking feature in the whole Island, and is best seen on the road from Balangoda to Haputale. The scarp forms a distinct mountain wall, sweeping in a broad arc from Adam's Peak in the west to Ellakanda in the east.

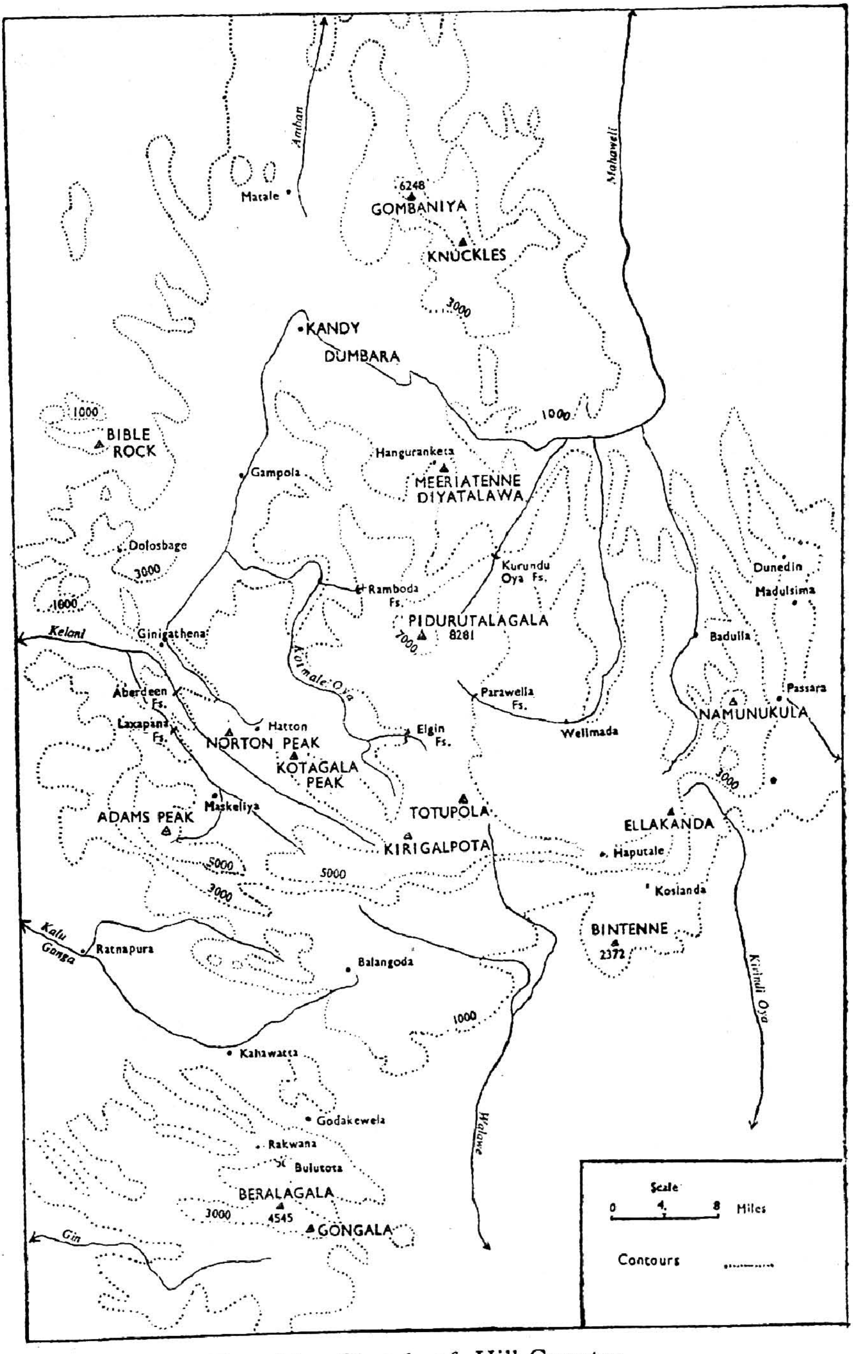


FIG. 10.—Sketch of Hill-Country.

It is more continuous in the west, but in the east it narrows to Haputale Gap and then swerves north. Beyond Ellakanda the scarp is dissected; it is resumed as a broken ridge beyond the Ella gap and runs as Namunukula ridge. Parallel to the latter and separated from it by the Passara gap is the Madulsima-Dunedin ridge.

Two amphitheatres have been planed out of the second terrace, where the country rocks are Khondalites—the Uva Basin and the Hatton Plateau. The Uva basin centres round Welimada and has an average elevation of 3,000 feet. A general view of the basin is obtained on the railway journey between Pattipola and Diyatalawa, from where the grass-covered hills occupying the basin present a remarkable undulating velvety appearance.

The Hatton plateau unlike the Welimada basin has no nodality, as it has been dissected into a number of parallel ridges and valleys. It is divided by the Kirigalpota-Kotagala-Norton ridge into two parts, the south-western part draining into the Kelani Ganga, and the north-eastern into the Mahaweli. The Dolosbage hills continue the line of this divide. The Hanguranketa ridge indicates a link with the Knuckles Hills.

The first terrace of the Central Plateau, which has an average elevation of 1,700 feet, can be recognized in the Kandy and Balangoda plateaus. The edge of this terrace too is marked by a wall-like escarpment, best seen in the south-east of the Province of Sabaragamuwa, where it forms a prominent physical feature overlooking the upper Walawe Ganga valley. Though not so clearly marked it is seen also in the west, e.g. at Kadugannawa and Ginigathena, but in the north and east it is not easily recognizable.

The Knuckles Hills run from north-west to south-east and culminate in Gombaniya, 6,248 feet. They owe their name to the fact that viewed from Kandy their summits

resemble the knuckles of a closed hand. They are separated from the Central Plateau by the Dumbara valley, and from the Matale hills by the Amban Ganga valley, which gives easy access to the hill country from the northern plain.

The Rakwana Hills and Sabaragamuwa ridges are a denuded anticline completely separated from the Central Plateau by the main Kalu Ganga stream and the Kahawatta-Godakewela gap. The Gongala-Bulutota Plateau which forms its eastern portion culminates in the peak of Beralagala, 4,545 feet, but its westward and north-westward extensions though much lower in elevation (Kukulugala, 2,300 feet), consist of a number of parallel ridges, which have proved a serious barrier to communications. The only through route across them is provided by the main stream of the Kalu Ganga, which cuts through the ridges in the Nambapana gorge.

EXERCISES

1. Describe the chief relief features which serve to diversify the landscape of the coastal plain.
2. Describe the main features of the relief of the Hill-Country.

CHAPTER 4

RIVERS

The central position of the highlands of Ceylon gives it a drainage pattern that is essentially radial, the northward flowing rivers being longer than those flowing in other directions. Generally, rivers rising on the western slopes flow to the west coast, those on the southern slopes southwards, and so on. The only anomalous case is that of the Mahaweli Ganga. The main stream of this river rises in the Hatton plateau following at first a course parallel to the upper Kelani, but instead of entering the western lowlands, it turns northwards, makes an elbow bend round Kandy, and then flows eastwards through the Dumbara valley to Minipe, where it turns sharply northwards and finally north-eastwards to Koddiyar Bay.

The direction taken by rivers depends in the first instance on the original slope; but their subsequent development would depend on climate, especially rainfall, and on the underlying geological structure. Where a newly emergent land provides an initial seaward slope (Fig. 12) a number of parallel streams will be formed flowing directly from the watershed to the sea (Fig. 13). Such streams which are the immediate consequence of the uplift are known as *consequent* streams. As soon as these carve out their valleys, their valley sides will form secondary slopes down which tributaries can develop more or less at right angles to the original streams. Such a direction is practically at right angles to the original slope, and is therefore impossible before the valleys of the consequent rivers have been excavated. The tributaries are accordingly called *subsequent* streams (Fig. 14).

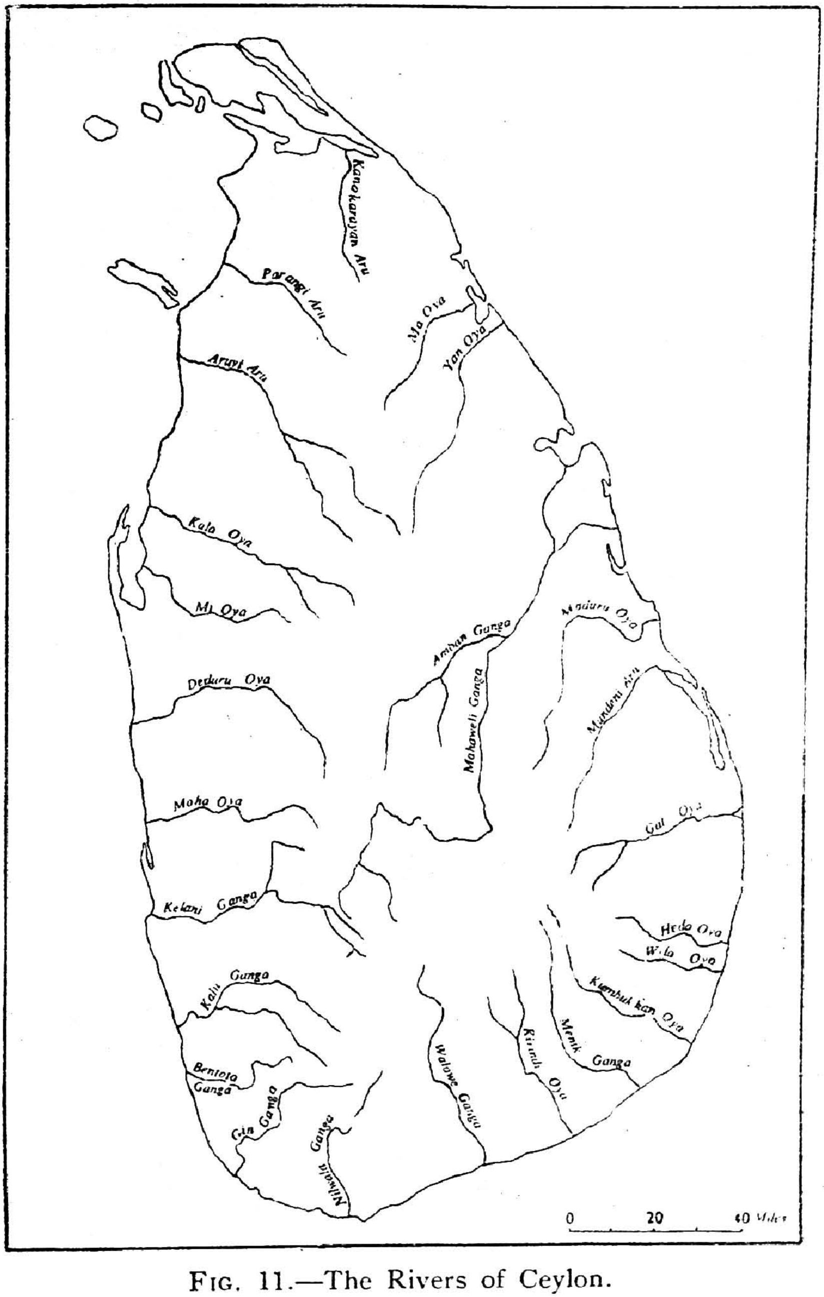


FIG. 11.—The Rivers of Ceylon.

Where the surface consists of alternately soft and hard beds dipping seawards, as in south-western Sabaragamuwa,

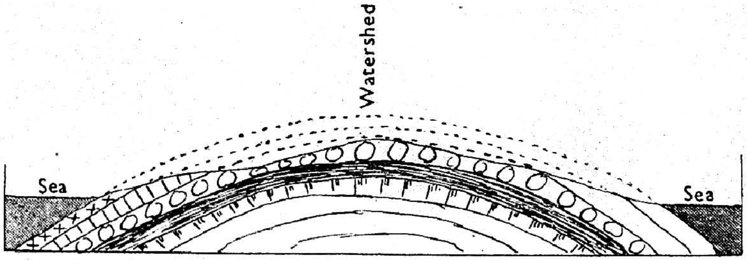


FIG. 12.—Section through a newly emergent land, the surface of which has been planed off by wave action.

the consequent valleys are narrow gorges where they cross resistant beds, and wide and open where they cross the softer beds. The subsequent tributaries develop only on the softer beds, and as they excavate their valleys, tertiary slopes will be formed in their valley sides, down which tributaries can develop, some of which will be opposite in direction to the original consequent streams, and are called *obsequent* (Fig. 15).

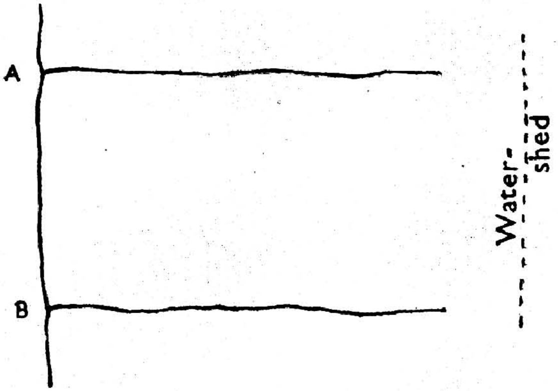


FIG. 13.—Map of part of left-hand portion of country shown in Fig. 12, showing First Stage in the development of a river system.

The rectangular drainage pattern formed by consequent streams parallel to the dip, and subsequent streams parallel to the strike is described as *trellised.* In regions of homogeneous rocks having no such banded structure, and

offering nearly uniform resistance to erosion, the subsequent tributaries will not be perpendicular but oblique in direction to the main stream. They will follow the resultant slope of valley side and general regional slope. These in turn develop their own branching system, and a tree-like or *dendritic* drainage pattern results (Fig. 16).

No river can erode above its source, but nevertheless there is a tendency for a river valley to grow backwards

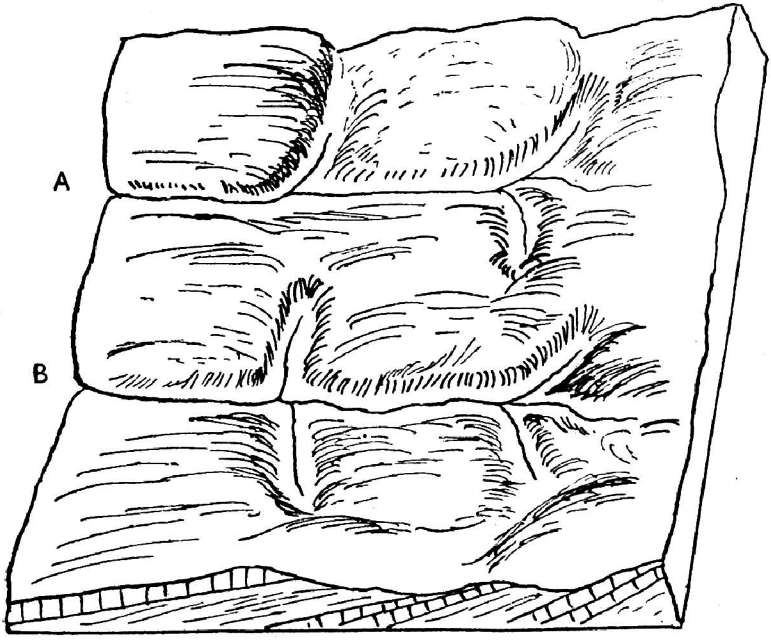


FIG. 14.—Development of river systems, Second Stage: formation of subsequent tributaries to consequent streams A and B.

into the land by headward erosion as a result of rainwash, gullying, and the creep and slump of surface materials at its head. The steeper the surface of the ground the more vigorous will be the rate of headward erosion. Thus, if two opposing slopes are unequally inclined, the original

divide will be pushed back towards the side with the gentler slope.

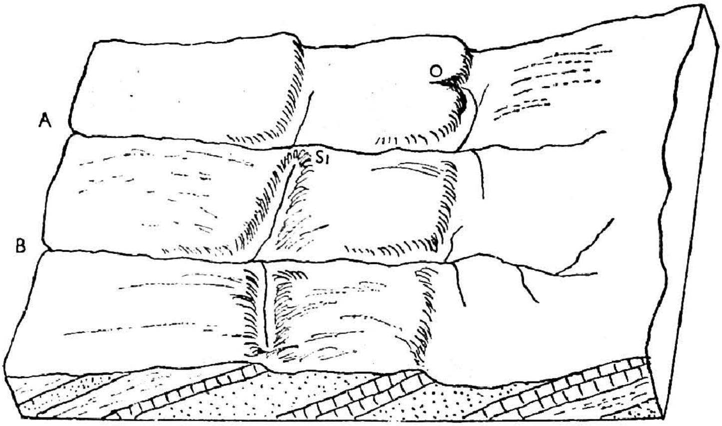


FIG. 15.—Development of river systems, Third Stage: Trellised Drainage developing scarpland topography. Impending river capture by subsequent stream, s_1. Obsequent stream at o.

As a result of this headward erosion by individual streams, what was originally a fairly straight divide may develop bends and become zig-zag. Where a headstream on one side of the divide cuts back directly in the direction of another on the opposite side, a notch would form in the watershed which would develop into a *col* or *saddle* (Fig. 18).

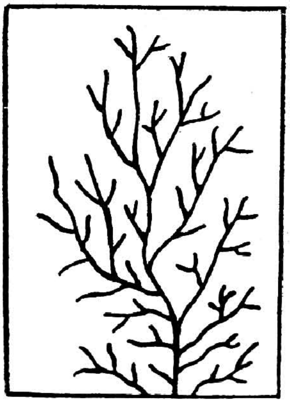


FIG. 16.—Dendritic drainage.

Migration of primary divides between two opposing sets of consequent streams does not, however, cause such striking changes as that of secondary divides between neighbouring consequent valleys (see Fig. 15). If as a result of some accident of rock structure or water supply, one of the consequent rivers, B, is larger or swifter

than its neighbour, it will excavate its valley more deeply. The secondary divide between the two is thus pushed back,

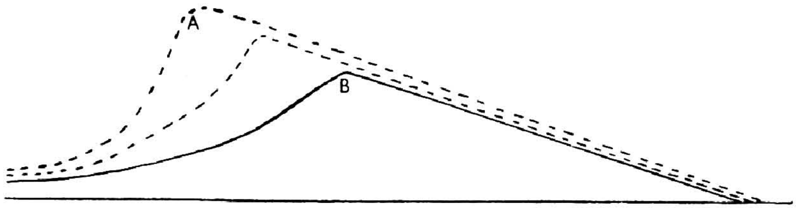


FIG. 17.—Section to show recession of watershed from A to B towards the side with the gentler slope.

and the more powerful river succeeds in diverting the head-waters of its weaker neighbour into its own valley. This process is known as beheading or *river capture*, and occurs most commonly when a major river has a vigorous subsequent tributary working along a relatively soft bed

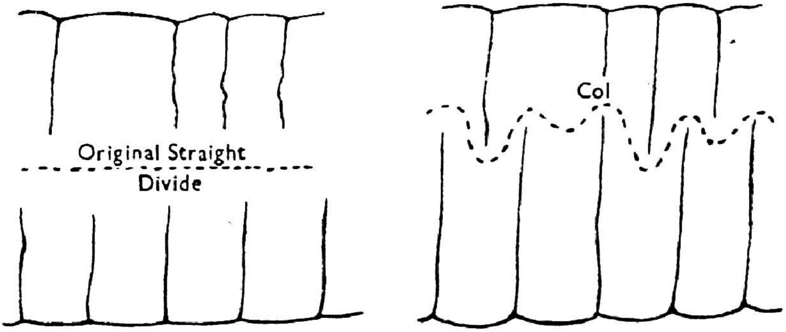


FIG. 18.—Development of zig-zag watershed.

(Fig. 15). The figure shows how a subsequent tributary of river B has cut back its head very close to river A, approaching it at a lower level than that at which the latter stands at that spot. During a time of flood some water will spill over the narrow neck above S_1 from river A to river B. The occurrence is repeated, the head of the

stream S_1 cuts back further, and ultimately the entire flow of the upper basin of river A is diverted into stream S_1 to swell the volume of its parent river, and still further increase its erosive power (Fig. 19). The sharp bend, e, at

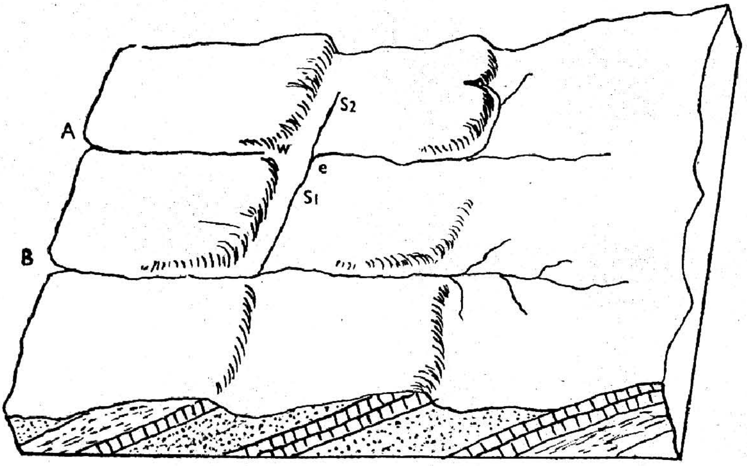


FIG. 19.—Development of river systems, fourth stage. Wind gap at w.

the point of diversion is known as the elbow of capture. The lower part of river A, now deprived of its upper waters, continues as a diminished stream in a valley that is much too large for it. Such a river is known as a 'misfit'. The gap through which it once flowed is now left high and dry and forms a 'wind gap', its new source being somewhat below it. A subsequent stream, S_2, which originally entered the captured stream at or above the elbow, now acquires a steeper gradient and may work back more vigorously to capture a neighbouring consequent. Thus the original river B with the help of its subsequent tributaries may acquire a very large drainage area at the expense of its neighbours.

River capture is a common occurrence in the development of drainage systems, and we have several examples

of it in Ceylon, some fairly recent and quite obvious, others older and rather problematical. For instance, the valley of the Amban Ganga below Matale appears to continue the direction of the upper Mahaweli Ganga above Katugastota. The Mahaweli Ganga must have at one time flowed directly into the Amban Ganga, but a stream occupying the Dumbara valley has cut its source backwards, and diverted the drainage of the upper Mahaweli at Katugastota, causing the present elbow bend in the river at the point of capture. The beheaded Amban Ganga is thus a misfit stream, much too small for its wide valley. The other remarkable bend in the present Mahaweli near Minipe probably marks another elbow of capture. The direction of the Dumbara stream—a consequent valley—is continued by the upper Galoya valley, but the vigorous headward erosion of a subsequent stream along a softer bed has resulted in the diversion of the river northwards at a point a few miles below Minipe.

If we follow any river up to its source in the hills, we shall find that it takes its rise, not right at the top of a hill, but somewhere down the slope at a point where water oozes out of the ground in the form of a spring. No permanent stream will take its rise at the very top of a hill, for the simple reason that there will be no supply of water there except when it is actually raining. Some of the rain will, however, soak into the hill and escape as a spring lower down the slope. The upper part of the hill thus serves as a kind of sponge, which holds the water that soaks in after rain, and only allows it to escape gradually. If the next shower of rain falls before all the water from the spring escapes, the spring will become the source of a permanent stream.

The course of a typical river falls into three sections:

(1) The upper course or mountain tract,

(2) The middle course or valley tract,

(3) The lower course or plain tract.

The mountain tract. In its mountain tract where its slope is steepest, the river is a torrent, and its work is mainly destructive. After heavy rain the increase in its volume enables it to move large pebbles and fragments of rock which form powerful tools of erosion, by which it deepens its bed to form a gorge or V-shaped valley. The material (or load) carried by the river consists of fragments of various sizes. The finest particles of mud are carried in suspension, grains of sand move along the bottom, while pebbles are rolled along intermittently. The larger boulders are moved only during occasional floods. The transporting power of a river depends on the one hand, on the shape, size and weight of the fragments, and on the other, on the volume and speed of flow of the water. As the velocity increases, the transporting power is increased in more than simple proportion. A river's transporting power, in fact, increases as the sixth power of its velocity. Thus, if a stream during a flood flows twice as fast as usual, its transporting power becomes 2^6 or 64 times greater, while if its velocity is trebled, its transporting power will increase 3^6 or 729 times. This very rapid increase of transporting power as the velocity increases, explains how many huge boulders in many a mountain stream got there. The stream itself brought them down from higher up, where they rolled into its bed under the influence of gravity.

Where the stream flows over a rocky bed, there often occur circular cavities known as *pot-holes* drilled into the solid rock. At the bottom of these will be found several rounded stones, which have been instrumental in drilling out the holes under the influence of swirling eddies. Such pot-holes may be seen in many of our mountain streams, e.g. in the Mahaweli Ganga at Getambe, or in the Kehelgamu Oya at Laksapanagala. By enlargement such pot-holes may join up, and in time a small gorge may be cut in the rocky platform.

If the supply of debris exceeds the amount that the river can carry, or if the velocity of its current is checked, part of the material will be dropped, and that in order of size, the larger fragments being deposited first. Thus a river begins to sort out its material almost as soon as it receives

[P. G. Cooray

FIG. 20.—Bed of mountain stream at Madulkele, showing potholes and joints.

it. There is a gradual change from the boulders and pebbles of its mountain tract to the sand of the valley tract and the fine silt of the plain.

In a river like the Kelani Ganga, the mountain tract may be said to end a little below the Aberdeen and Laksapana Falls, while the valley tract may be considered as extending from there to about Yatiyantota or Ruwanwella. In most cases, however, the transition from mountain tract to valley

tract is more gradual. Since a river which flows into the sea must have a slope towards the sea, the deepening of its valley must needs be limited by sea-level. The level of the sea or lake into which a river flows thus acts as a *base-level*, below which the river cannot cut its bed. Thus as a stream approaches its base-level, its power of downward cutting is greatly diminished. Hence in the mountain tract downward cutting is at a maximum, while in the plain tract it is at a minimum.

In the valley tract, the confluence of several tributaries has increased the volume of water, but as the river is nearer its base-level, its gradient is necessarily less steep, and the velocity of its current is reduced. The heavier part of its load is accordingly dropped, and its downward cutting power is reduced considerably, thus allowing the action of rain and the processes of weathering to wear back the valley sides. Also, though down-cutting is reduced, the river still has energy, and this is used up in lateral cutting, thus widening its valley into a more open V. Here and there, we shall find narrow patches of flat ground fringing the river, now on one side, now on the other. These have been built up by the river, especially at points where tributaries join the main stream. With the sudden change in gradient where the stream enters the valley tract, it is unable to carry all the material brought down by its swift upper waters, and some of it is dumped down to form a piedmont alluvial fan or cone.

In its lower course or plain tract the gradient becomes so gentle that the river deposits more than it erodes. The separate river side flats of the valley tract merge here to form a wide alluvial plain. The river seldom keeps to a straight course, as it is liable to be turned aside by the slightest obstacle. Once a bend is formed, the tendency will be for the river to accentuate it. This is because the current impinges with greater force on the concave side of the bend.

On this side, therefore, the bank is steepened and may form cliffs, while on the opposite side is a gentle slope bordered by a bank of sand and silt. In times of flood the river overflows its banks and inundates a wide area—the flood plain. When the floods have subsided, a layer of silt is left covering the flood plain, and helps to level up any irregularities in it by accumulating to a greater thickness in the hollows. After the floods have subsided, the river may be found to occupy several channels forming a braided stream. This is the case with many rivers of the Eastern Province. Where deposition is at a maximum near the mouth of a river, the obstruction may be great enough to force the river to burst its banks and acquire two or more outlets into the sea. This has happened in the case of the Mahaweli Ganga, where one mouth, known as the Verugal Aru, enters the sea south of Seruwawila, while the main stream empties into Koddiyar Bay by three other mouths. This branching marks the beginning of delta formation. The rivers are thus too shallow for navigation, though in the wet zone their lower courses are used by padda boats.

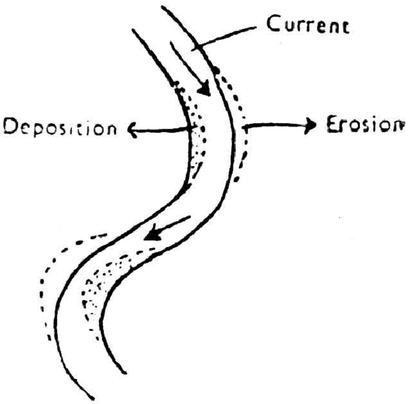


FIG. 21.—Accentuation of river bends.

We shall conclude this section by a description of the Kelani Ganga basin. A description of the other river basins on similar lines is left as an exercise to the student.

The furthest headstream of the Kelani Ganga, the Bogawantalawa Oya, takes its rise on the south-western slopes of Kirigalpota, and flows north-westward in a

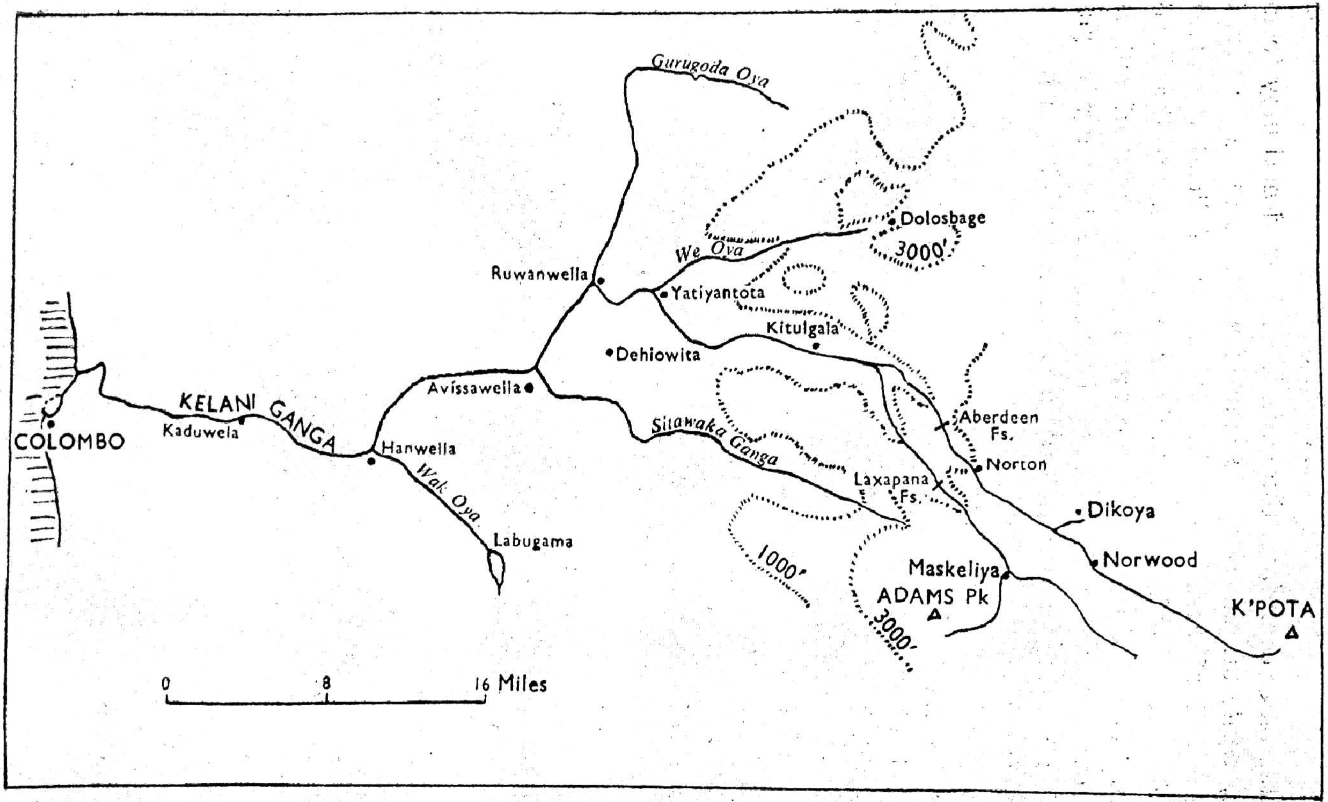


FIG. 22.—The basin of the Kelani Ganga.

longitudinal valley as the Kehelgamu Oya past Norwood and Norton Bridge, where it has been dammed to form a reservoir for the Hydro-electric scheme. About four miles below Norton, the river leaves its mountain tract by a leap over the Aberdeen Falls, but continues in the same direction for another three miles. It then turns westward to cut transversely across the ridge which separates it from its tributary, the Maskeliya Oya, which after tumbling over the Laksapana Falls, joins it a few miles above Kitulgala. The combined stream now flows in a deep gorge to Yatiyantota, where it is joined by a right-bank tributary, the We Oya, which comes down from the Dolosbage Hills. Five miles further west it receives the Gurugoda Oya from the north, which joins it at Ruwanwella, and the river now flows southwards to Avissawella, where it is joined by a left-bank tributary the Sitawaka Ganga, coming from the Adam's Peak region. In its lower course, the river flows generally westward past Hanwella, Kaduwela and Kelaniya, reaching the sea just north of Colombo. The road along the river is generally liable to interruption by floods after periods of heavy rain. Lying as it does entirely in the wet zone, the river is second only to the Kalu Ganga, among all Ceylon rivers, in the volume of water it discharges into the sea.

Not every river will fall into the three well-defined sections of mountain, valley, and plain tract. Some rivers, like the Kanakarayan Aru, may have a course which is entirely in the lowlands; in other cases, like the Walawe Ganga, there may be little or no valley tract, while in still others, especially where a mountain range lies close to the coast, a river may empty directly into the sea from its mountain or valley tract, with little or no development of flood plain.

The following table gives the lengths of the chief rivers, and the extent of their catchment areas:

RIVER	LENGTH IN MILES	CATCHMENT AREA IN SQUARE MILES
Mahaweli Ganga	206	4,034
Aruvi Aru	104	1,268
Kala Oya	97	1,044
Yan Oya	94	594
Kelani Ganga	90	885
Deduru Oya	87	1,022
Maduru Oya	86	602
Walawe Ganga	83	954
Menik Ganga	81	497
Maha Oya	78	590
Kirindi Oya	73	455
Kalu Ganga	70	1,050
Gin Ganga	70	370
Kumbukkan Oya	70	656
Mi Oya	67	675
Gal Oya	62	700
Mundeni Aru	50	500
Kanakarayan Aru	48	350
Nilwala Ganga	40	375
Ma Oya	40	400

Lagoons and Coasts

Many rivers have their mouths obstructed by sand bars, which in some cases have diverted their mouths. Thus the Tuntota (or Karambalam) Oya, after reaching within one mile of the west coast near Madampe (old town), turns at right angles and flows northwards as the Lunu Oya for nearly four miles to enter Chilaw lagoon. An example of more recent sand bar formation is found in the bar at

Kalutara, which diverts the Kalu Ganga to an outlet some distance south of the bridge. When there is danger of floods, this sand bar is often breached artificially to secure more rapid drain-off of surplus water. The extremity of a growing sand bar is known as a spit, and often has a characteristic hooked shape, e.g. the southern sand bar in the Kalutara lagoon (Fig. 23).

It is only where the coast is rising or stable, that accumulation of drifting sand can take place. Behind the spits and on the shores of the lagoons, sedimentation is active, and salt water plants and mangroves by colonising the mud help to fill up the lagoon, and convert its head into marsh and swamp. The Muturajawela swamp at Jaela is an example of such silting (see Fig. 24).

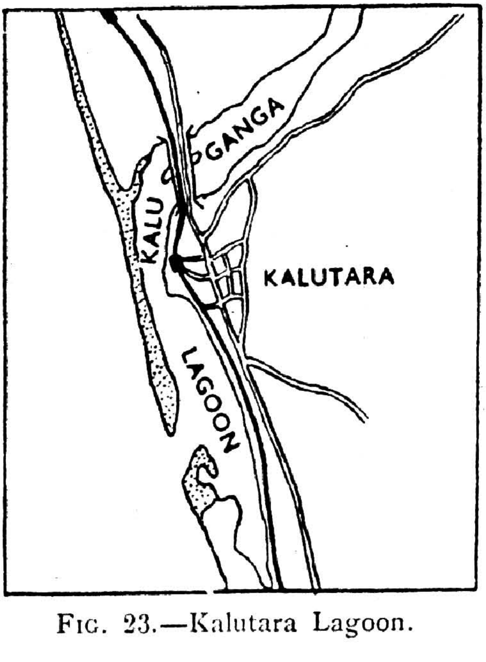


FIG. 23.—Kalutara Lagoon.

The decay of successive generations of swamp-loving plants here has led to the formation of peat, a substance which can be dug up, dried and used as fuel. Such swamps can often be reclaimed and converted into good agricultural land. Barrages may be constructed to exclude sea water, and canals cut to drain off surplus rain water. Such lands can be cultivated with salt resistant varieties of paddy, and this is already being done at Muturajawela, Hikkaduwa and elsewhere.

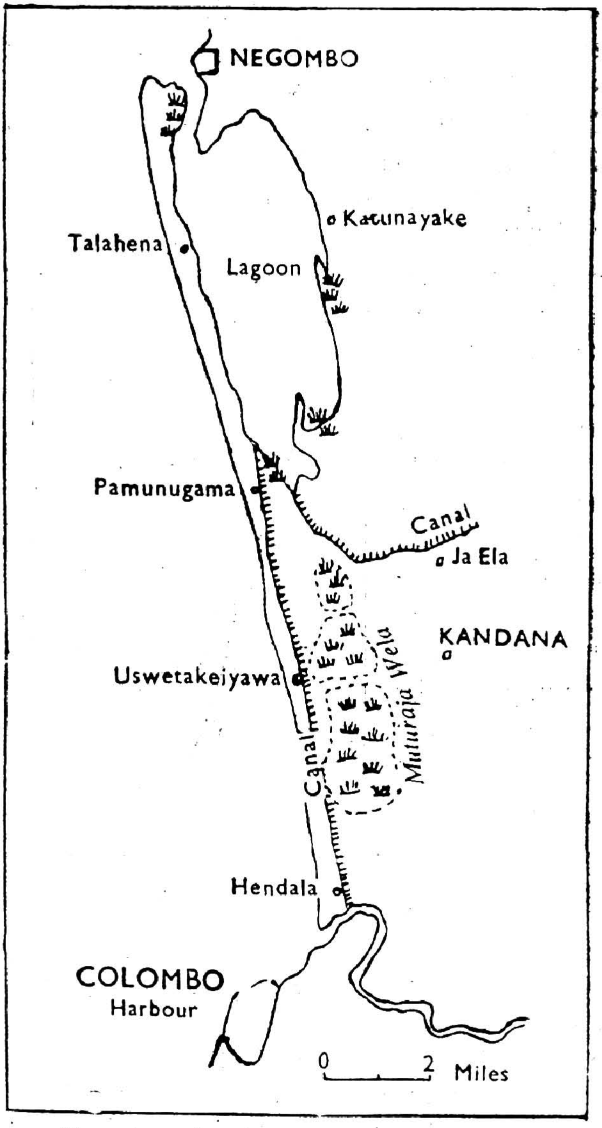


FIG. 24.—Lagoon and Swamp coast. Negombo Lagoon and Muturajawela.

On the seaward side of the sand bar, however, the soil is mainly sandy, and is thrown up by the wind into low

hills (sand dunes) which may be quite bare. Where the soil is older, it may be covered by scrub vegetation, and after it has acquired some fertility by the decay of successive

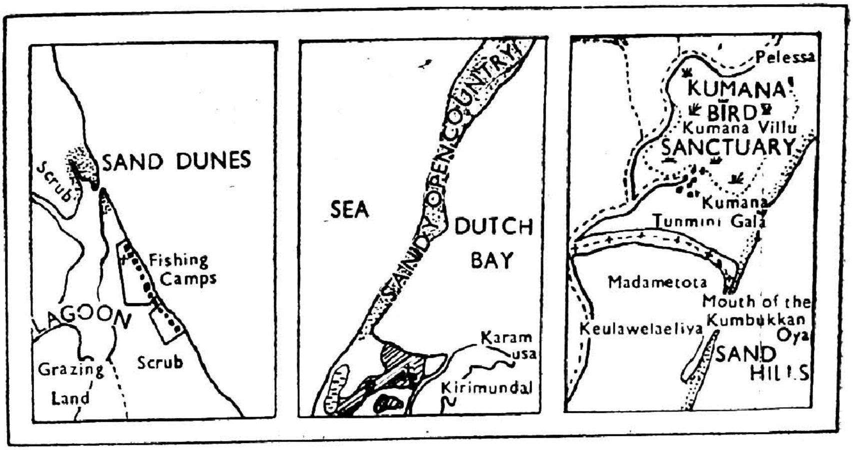


FIG. 25.—Sandy and Dune coasts.—From Kokkilai, Kalpitiya and Yala one-inch topographical sheets.

generations of plants, it may be brought under palmyra or coconut cultivation. All these stages may be observed on

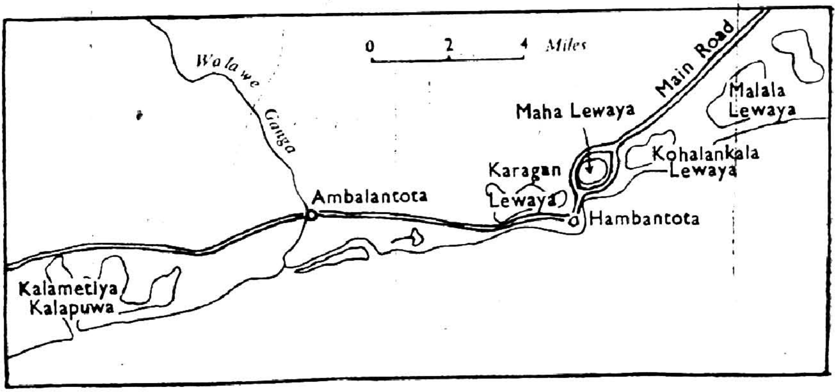


FIG. 26.—Lewaya coast.

the coast from Negombo to Puttalam. South of Colombo, however, the coast is seldom bare, and is usually under coconuts.

On our south and south-east coasts we find peculiar

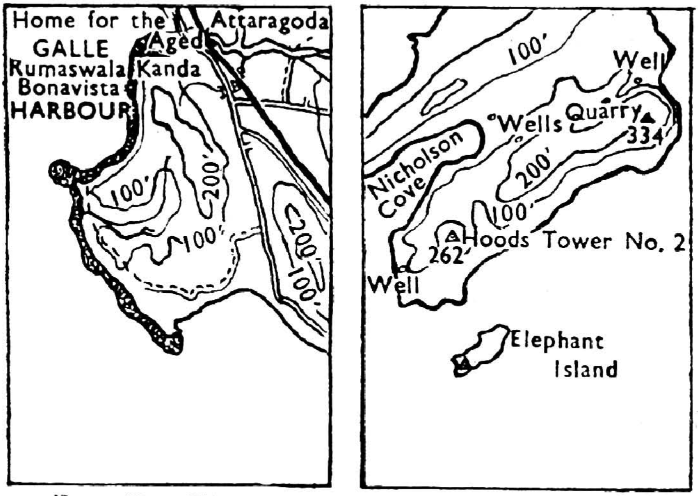


FIG. 27.—Cliff coasts—Galle and Trincomalee.

depressions known as *lewayas*. These serve as natural

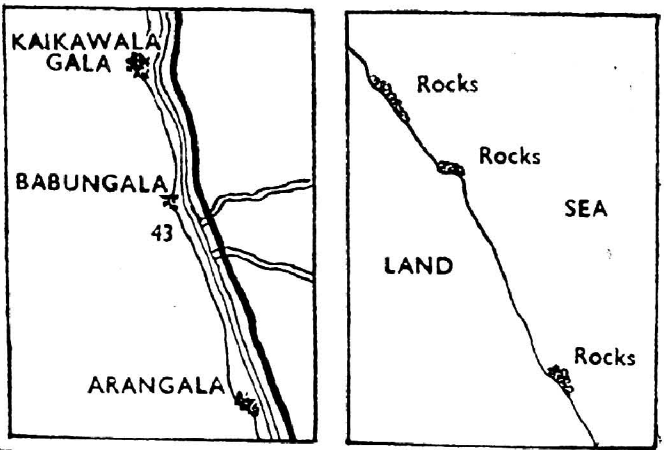


FIG. 28.—Rocky coasts—off Alutgama and Kokkilai.

salterns in which sea water evaporates, to leave a good accumulation of salt in the dry season, July-August. It

PLATE I

Cliffs at Fort Frederick, Trincomalee, showing joints and bedding.

[*Photo by Platé Ld.*

would seem that these lewayas were once arms of the sea. but have now got separated by deposits of sand obstructing their mouths. The earlier stage with the mouths permanently open may also be seen, and are known as *kalapuwas*.

In regions where subsidence has taken place, or where the coast is sinking, we find that the shore is rocky and sometimes bordered by cliffs. Examples of this submergent type of coast are found at Trincomalee, and at a few points on the south and west coasts.

EXERCISES

1. Describe with the aid of sketches the various types of drainage pattern known to you.
2. What do you understand by river capture? Describe with the help of sketches the various features associated with it.
3. Into what three sections would you divide the course of a river? Describe its work in each part of its course.
4. Draw a sketch-map of the basin of the Mahaweli Ganga, marking the three sections. Mark one important town in each section. Insert and name three important tributaries.
5. Describe the chief types of coast met with in Ceylon.
6. Explain the terms: col, pot-hole, base-level, braided stream, delta.
7. Give some account of the work of rivers in landscape sculpture.
8. Give an account of the processes of erosion and deposition, referring to examples actually known to you.

CHAPTER 5

CLIMATE—TEMPERATURE

Though Ceylon falls within the monsoon region of Asia, its climate as a whole is better described as equatorial. The typical development of the latter, however, is confined mainly to the south-western quadrant of the Island. One might for this reason assign the so-called dry zone to the tropical monsoon climate, not of the normal variety of summer-rain and winter-drought, but of the special type that occurs on the Madras coast of South India, where it is the cool season that is ushered in by the rains.

TEMPERATURE

The temperature of Ceylon depends on the following factors:

(1) Latitude, (2) Altitude, (3) Distance from the sea, (4) The season of the year.

The effect of latitude is seen in the small annual range of temperature, which ranges from 3.2°F. at Galle to 7.7°F. at Trincomalee. The range of temperature increases not merely from south to north, but rather from south-west to north-east. This is due to the fact that in the south-western parts the dry season is very short and the heat is modified by the rains. In the north and east, on the other hand, the dry season is more prolonged and the hot season is not tempered by rains, while the cool season temperatures are lowered by the prevalence of northerly winds.

As usual in tropical regions, the diurnal range is much greater than the annual range, the difference between day and night temperatures being greatest during dry weather, when there are few clouds to screen off the sun by day,

or keep in the heat at night. Thus at Nuwara Eliya, there are days in January and February when the diurnal range may exceed 40°F. On such nights the minimum may fall below freezing point, the lowest temperature ever recorded being 27°F. The average diurnal range for the year for inland stations is, however, about 17.5°F. at Badulla and Nuwara Eliya, and decreases to about 10°F. at the coast, being smallest at Galle, where it is 8.4°F., thus showing the influence of the sea. In Colombo the average diurnal range for the year is 11°, varying from 8° in June and July to 15° in February. At Nuwara Eliya the diurnal range varies from 10° in June and July to 25° in February.

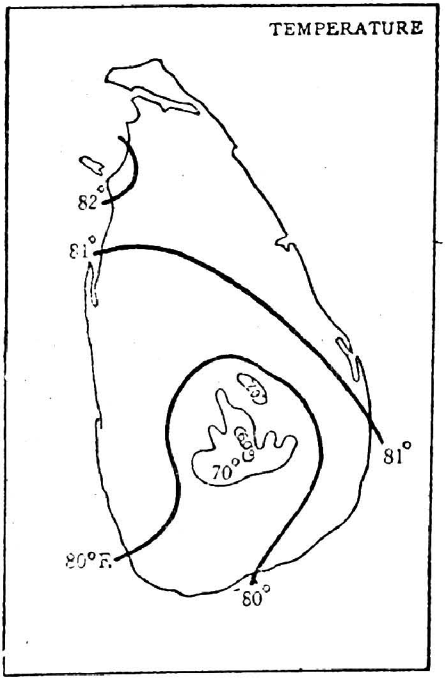


FIG. 29.—Distribution of Temperature.

In the lowlands the average temperature for the year is about 81°, being slightly higher in the drier north and east, and slightly lower in the more humid south and west. Thus at Trincomalee it is 82.1°, while at Galle it is 79.8°.

In the hill country the temperatures are lowered on an average at the rate of 1°F. for every 300 feet of ascent. Thus at Badulla (2,200 ft.) the average temperature for the year is 7° lower than at Colombo, at St. Coomb's, Talawakele (4,500 ft.) 15° lower, and at Nuwara Eliya (6,150 ft.) about 20° lower.

The effect of the seasons is seen in the drop in the temperature that accompanies the monsoonal rains, and the generally lower temperatures of December and January.

The following are the average temperatures for the 16 climatological stations for which reliable records are available. These cover a period of only about 24 years, and are based on the figures given in the Annual Report on the Colombo Observatory.

AVERAGE MONTHLY TEMPERATURES IN °F.

Station	J	F	M	A	M	J	J	A	S	O	N	D	Year
Colombo ...	79·2	79·6	81·0	81·9	82·3	81·4	80·9	80·9	81·0	79·9	79·4	78·9	80·5
Galle ...	78·4	79·4	80·7	81·4	81·6	80·4	79·8	79·6	79·8	79·2	79·0	78·4	9·7
Ratnapura ...	80·2	81·4	82·2	82·4	81·9	80·6	80·6	80·5	80·4	80·0	80·0	79·8	80·8
Kurunegala ...	78·2	79·8	82·4	82·8	82·6	81·0	8[illegible]·8	80·9	81·0	80·3	79·5	78·2	80·6
Kandy 1,600′ ...	75·2	76·8	78·8	79·2	79·1	77·2	76·7	76·7	76·8	76·4	76·0	75·2	77·0
S. Coomb's Estate, Talawakele, 4500′	64·8	65·4	66·6	67·6	67·6	65·5	64·8	65·2	65·2	65·3	65·4	64·8	65·8
N. Eliya 6,150′ ...	57·2	57·2	58·6	60·4	61·8	60·6	60·0	60·2	60·0	59·8	59·4	58·2	59·4
D'lawa 4,100′ ...	64·6	65·8	67·7	69·1	70·3	70·[illegible]	70·3	69·8	69·4	68·4	67·0	65·3	68·2
Badulla 2,200′ ...	70·0	71·[illegible]	73·3	75·2	75·9	[illegible]5·4	75·2	75·2	75·[illegible]	74·2	72·4	7[illegible]·6	73·6
Batticaloa ...	77·5	78·3	80·2	82·2	84·0	85·0	84·6	83·4	83·0	81·2	79·2	77·8	81·3
Trincomalee ..	77·8	79·1	80·[illegible]	83·4	85·4	85·6	85·3	84·7	84·6	81·8	79·2	77·9	82·2
A' pura 300′ ...	76·2	78·2	81·4	83·0	83·6	83·0	83·4	83·5	83·4	81·2	78.8	76·6	81·0
Jaffna ...	77·5	79·6	82·2	84·8	84·8	83·8	83·0	82·6	82·8	81·7	79·4	77·8	81·6
Puttalam ..	77·7	79·2	81·4	82·6	83·5	82·7	82·2	82·2	82·4	80·9	79·4	78·0	81·0
Mannar ...	78·7	79·9	82·2	84·2	85·1	84·4	83·3	83·0	83·2	82·1	80·1	78·8	82·1
Hambantota ...	78·8	79·4	80·6	82·0	82·2	81·6	81·8	81·5	81·4	80·8	79·6	78·8	80·4

The monthly march of temperature of a few of these are shown graphically in Fig. 30. The student should supplement these by drawing graphs for a few others. It will be found that the temperature curves for most places show two maxima during the periods of the overhead sun, the principal maximum being in April-May, just before the onset of the South-West Monsoon. When the rains arrive, the temperature falls, both because the monsoon itself is a cool wind having its origin in the winter hemisphere, and be-

cause the rain and cloud associated with it intercept the sun's rays, and for the same reasons it does not rise so

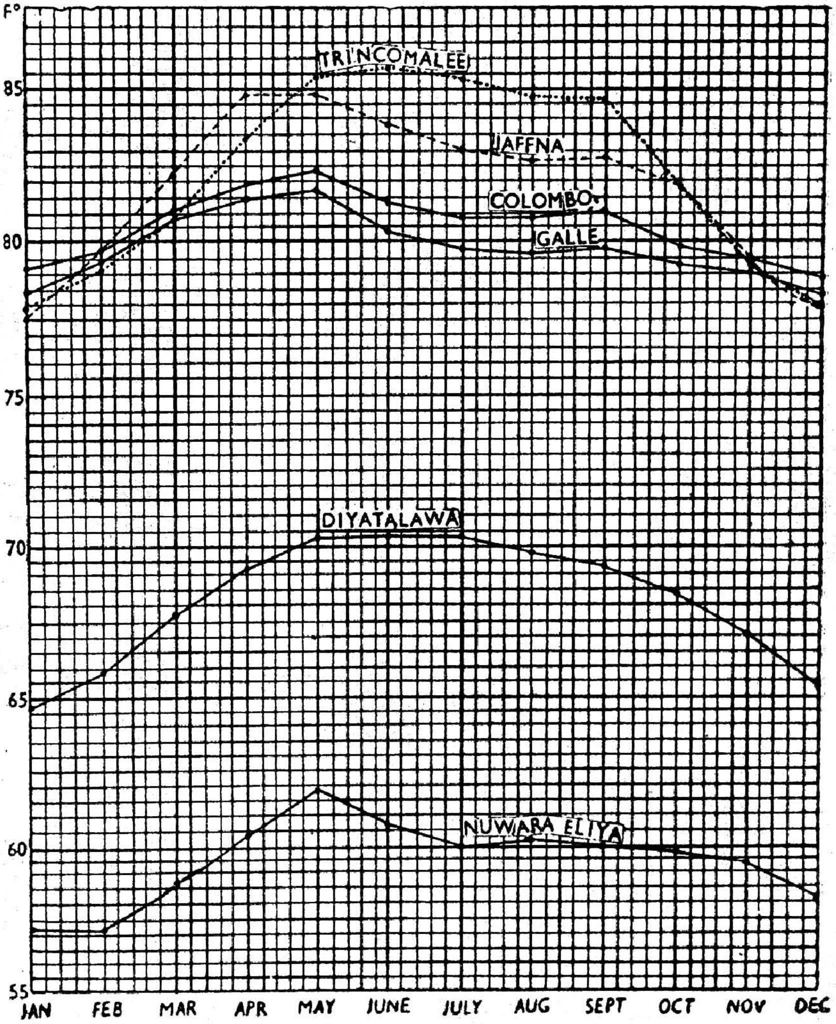


FIG. 30—Temperature Graphs.

high a second time, when the sun is overhead again in September.

In the Eastern Province which lies to the lee of the

Central Hills, the S.W. Monsoon is felt as a warm dry wind—the Kachchan. This is because, deprived of its moisture in its ascent on the windward side, it becomes heated by compression in its descent on the leeward side, the heat being greatest in June when the wind is strongest. Thus stations like Trincomalee and Batticaloa show a continued rise in temperature to a single maximum in June. Where, in the absence of a mountain barrier, the Chinook effect cannot operate, as in Jaffna and Mannar, the maximum occurs in April-May.

The degree of physical discomfort felt by the human body is not determined by the temperature alone—it is rather a combined function of temperature, humidity and circulation of the air. In a dry atmosphere, a considerable amount of evaporation takes place from the human skin, and the body is thereby cooled, but when the atmosphere is damp, evaporation is retarded, and this cooling influence is absent. A hot climate is therefore made more oppressive by the high humidity of the air: clothing becomes messy with excessive perspiration, and disinclination to physical exertion becomes great. On the other hand, when there is a strong wind, the feeling of discomfort is less, because evaporation is increased. Thus in the northern plains, e.g. at Jaffna and Mannar, April and May are the most unpleasant months, on account of the absence of any strong wind.

The relative humidity of the air in the wet zone varies generally from about 74% during the day to about 90% at night, rising as the temperature falls. In the dry zone these values are lower by about 5%, and in the driest months the humidity during the day may go down to about 60%. The average relative humidity for the year at Colombo is 82%, being 74% by day and 90% by night. It is lowest in February, when it averages 80%, and highest in October and November when it is 84%. At Diyatalawa, the average for the year is 76%, being lowest in June when

it is 68%. At Nuwara Eliya the average relative humidity for the year is 83%. It is least in February when it comes down to 74%. One effect of humidity is that it reduces the annual range of temperature. Thus wet zone stations, with their higher relative humidity, show a smaller range than those of the dry zone. The other effect is that the rise of humidity at night makes the night temperatures of April and May in the lowlands as oppressive, if not more so, as the day temperatures.

EXERCISES

1. To what type of world climate would you assign Ceylon? Defend your assignment.

2. What factors govern the distribution of temperature in Ceylon? Illustrate your answer by examples.

3. Draw graphs to illustrate the monthly march of temperature at Kandy, Batticaloa and Talawakele. Comment on the main features of your graphs.

CHAPTER 6

CLIMATE—RAINFALL

The distribution of the mean annual rainfall of Ceylon for the years 1911-40 is shown in Fig. 31. This is the standard period adopted by the Department of Meteorology, and is based on the map given in the latest issue of the Report on the Colombo Observatory, which the student should consult for further details. Forecasts of the weather are now regularly made by the Forecasting Centre, Ratmalana, and are issued to the Press daily at about 7 p.m. for insertion in the morning papers of the following day.

The main feature of the regional distribution of rainfall is the concentration of the rainfall in the central and south-western parts of the Island,—an indication of the major contribution made to the Island's rainfall by the South-West Monsoon. The regions of heaviest rainfall lie on the slopes of the hills that directly face the monsoon winds. Over the Central Highlands the moisture laden winds are compelled to rise and drop their moisture on the windward slopes. On the north-eastern side of the hills, only a narrow strip, occupying the crests and north-eastern slopes of the Knuckles Hills, gets over 150 inches, but in the south-west this amount of rain falls over a much larger region, somewhat elliptical in shape, and extending from Udugama in the south to Bulathkohupitiya in the north. The region includes Watawala, Ginigathena, Adam's Peak, Ratnapura, Ruwanwella, Avissawella, Labugama, Agalawatte and Hiniduma. Within it occurs a smaller area of exceptionally heavy rainfall—the Adam's Peak-Watawala region, which gets over 200″.

Marked rain shadows occur (1) in the middle Mahaweli Ganga valley (*a*) near Mahaiyangana, (*b*) round Mailapitiya (Milapitiya) and Rajawella to the south-east of Kandy, and (2) in the Uva Basin (Diyatalawa-Welimada-Badulla).

The regions of lowest rainfall (under 50″) lie in the north-west and south-east of the Island. Over these parts

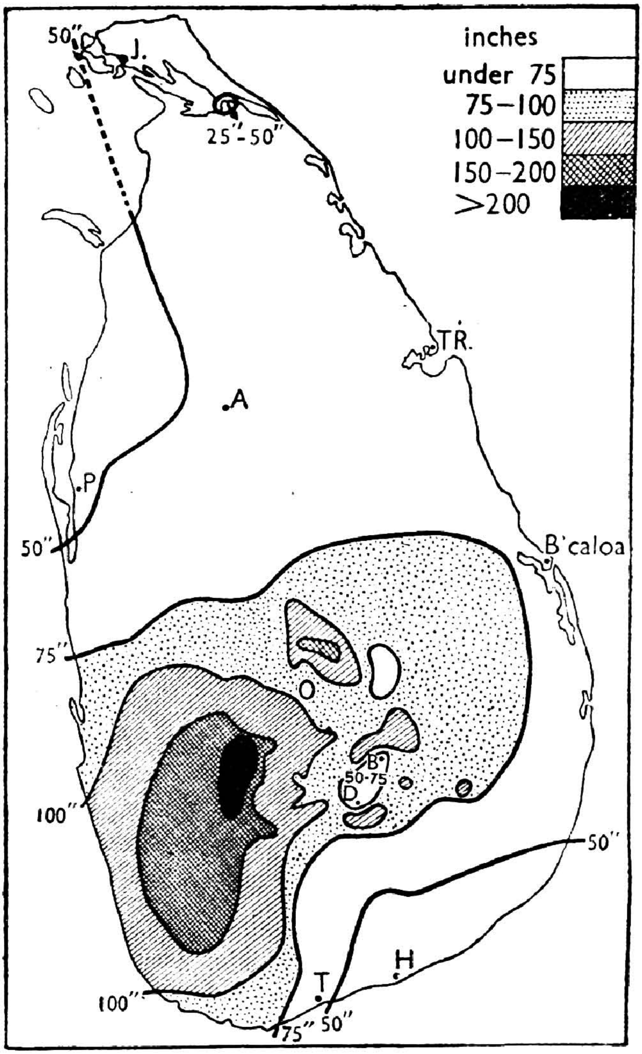


Fig. 31.—Mean Annual Rainfall of Ceylon.

the passage of the monsoon winds is unobstructed, and they just blow over without parting with any of their moisture.

Though the Island as a whole may be said to have a high rainfall, great variations occur from year to year, and all regions with a rainfall of below 75 inches may be described as insufficiently watered, cultivation being not generally successful without irrigation. The lowest rainfall average, 36.3″ occurs at Yala on the south-east coast, but Marichchukaddai in the north-west is almost as dry, 37.8″.

In order to understand the seasonal distribution or rainfall, it is necessary to examine the types of air movement

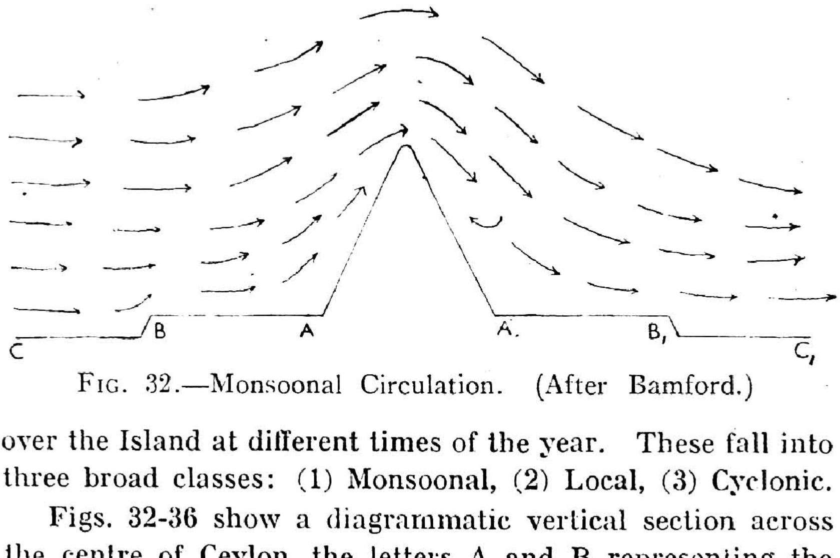


FIG. 32.—Monsoonal Circulation. (After Bamford.)

over the Island at different times of the year. These fall into three broad classes: (1) Monsoonal, (2) Local, (3) Cyclonic.

Figs. 32-36 show a diagrammatic vertical section across the centre of Ceylon, the letters A and B representing the low-country on the windward side, C representing the sea, and the letters with dashes the corresponding areas on the leeward side. The length of the arrows is made proportional to the strength of the winds.

(1) *Monsoonal air movements.* The South-West Monsoon which blows from May to October is caused by the intense low pressures prevailing on the Indian sub-continent during summer. This low pressure causes an indraught of air from the ocean to the south. The resulting southerly winds are

deflected to the right as a result of the earth's rotation, and accordingly become south-westerly over Ceylon and South India. With the passing of summer, the Indian low pressure diminishes in intensity and disappears, and the normal planetary wind for the latitude—the north-east trade wind—asserts itself. This we call the North-East Monsoon, which blows from December to March. The term monsoon—contrary to the popular idea—is not synonymous with rain; it is derived from an Arabic word, *mausim* (season), and means a seasonal wind. The end of one monsoon does not synchronize with the arrival of the other. There is always a period of about four to six weeks in between, during which there is no monsoon current in either direction.

(2) *Local convectional air movements.* At such times, e.g. in April and November—though these periods are by no means confined to the limits of the calendar months—the circulation of air over the Island is due to purely local causes. With the heating of the land by day, a sea breeze sets in by about 10 a.m., and blows inland towards the hills (Fig. 33). As this air current is too weak

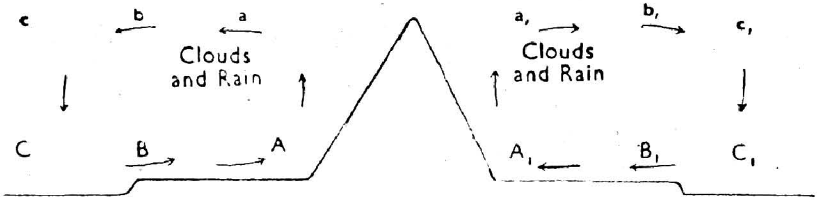


Fig. 33.—Convectional Circulation by day. (After Bamford.)

and shallow to surmount the obstacle of the central hill-country, the moist air collects at the foot of the hills, and when it has been heated sufficiently by conduction from the ground and radiation from it, convection currents are set up which by afternoon result in thunder-cloud formation and rain[1]. This rain generally occurs first inland at the

[1] Convectional rain is generally accompanied by much thunder and lightning. This is because when convection is very rapid, the drops of rain

foot of the hills, and then works outwards towards the coasts. Whenever convection is less intense, the rain gives out before it reaches the coast. Thus coastal areas may not have rain for several days in succession, even when thunderstorm activity is evident in the interior.

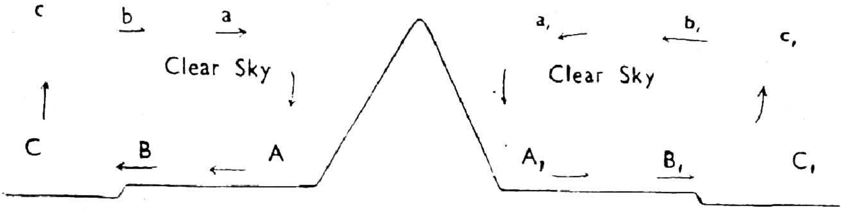


FIG. 34.—Convectional Circulation by night. (After Bamford.)

By night the circulation is reversed, and a land breeze blows out to sea. The clouds disperse and the sky becomes remarkably clear. Thus, the inter-monsoonal periods are characterized by fine clear mornings and afternoon and evening thunderstorms, which recur with monotonous regularity, unless some disturbing influence like the approach of a cyclonic depression upsets the daily rhythm.

Cyclonic Air Movements. Cyclonic depressions are another cause of rain. They are most common in the inter-monsoonal periods, March-April and October-November, but occur in other months as well. November is the month of greatest frequency. The old theory was that during periods of calm weather when the air is rather still, differential heating of the atmosphere over a warm sea studded with small islands, such as the Andamans and Nicobars may set

formed by condensation grow so large, that they become unstable and break up. In the process the larger particles acquire a positive charge of electricity, and the finer particles, blown high into the air by ascending currents, a negative charge. In this way the charges are separated, and so, an electric field, a 'longing', is generated. When a sufficient potential has accumulated, discharge occurs by the passage of a spark, which we see as a flash of lightning; the air, torn apart by the flash rushes together again, and sets all the atmosphere about it oscillating in angry sound waves, which reflected again and again from the cloud surfaces around, is the accompanying roll of thunder.

up centres of low pressure, which may serve as nuclei of tropical revolving storms or cyclones. But during the Second World War, operations in the South-East Asia theatre led to the intensive study of air conditions in the Indian Ocean, and the frontal theory of the origin of temperate cyclones was found applicable to tropical areas as well. The equatorial belt of the Doldrums is a zone of convergence of large air masses—the north-east and south-east trades. The boundary between them is known as the Inter-Tropical Front (or ITF), and is generally parallel to the Equator, but occasionally has a meridional alignment. In the latter case the opposing air masses differ more widely in physical characteristics, and the front is a real surface of discontinuity, recognized as the birth place of many tropical cyclones. Where the front bends from a latitudinal to a meridional position, the tendency to eddy is strong, and wind movements are conducive to revolving storms. The surface winds converge towards a low pressure centre, and produce a violent whirling movement as a result of deflection caused by the earth's rotation. The clouds, wind and rain increase from the margin inwards, though the centre itself is a region of calm air. South of about latitude 8° N., these storms are not of sufficient intensity to justify the use of the term 'cyclone', and are referred to as depressions, which are cyclonic in character, but have less violent winds. Though occasionally depressions form in the Arabian Sea and move eastwards, the most frequent depressions originate in the Bay of Bengal and move westwards. They thus appear to influence the eastern and northern parts of the Island rather than the south and west. Very often they result in overcast skies and two or three days of continuously unsettled weather, and if the paths of their centres happen to cross the Island, a narrow belt of country may experience exceptionally heavy rain. The heavier rainfall of November,

as compared with April, experienced in almost all parts of the Island, is due to the greater frequency of depressions in this month. Depressional rain, unlike that due to afternoon thunderstorms, is not confined to any particular time of the day, and unlike monsoonal rain, is not affected by the relief of the country. The following table shows the actual number of cyclonic depressions during the period, 1925-50:

J	F	M	A	M	J	J	A	S	O	N	D	Total
3	0	3	4	3	0	2	0	2	13	22	11	63

Apart from these depressions, another common type of disturbance is the so-called 'wave in the easterlies'. These waves are merely feeble troughs of low pressure, which move slowly westwards, especially through the trade wind belt of the summer hemisphere. Just behind the trough-line, the surface layer of air is extremely moist and attains great depth, giving rise to extensive areas of cumulus-like cloud with showers and thunderstorms. Easterly waves occur less frequently in winter, and when they do, are of much less intensity.

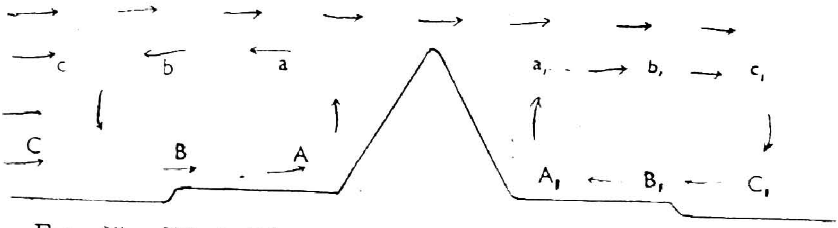


FIG. 35.—Weak Monsoon and Convection Currents by day. (After Bamford.)

The South-West Monsoon.—The first effect of a weak monsoon current will be (*a*) to cause an increase in the afternoon thunderstorm rain by strengthening the normal sea breeze by day (Fig. 35); and (*b*) to cause early morning rain by its opposition to the land breeze by night (Fig. 36). These conditions obtain at the beginning and end of the monsoon,

i.e. in April-May and September-October in the south-western lowlands.

The monsoon currents are rather shallow and not strong enough to smother the local circulation BAab, but will act at C as a reservoir for BAa. This means that the air which is drawn in at B, instead of being stagnant air that has stood over the sea for a short time, and so gathered only a moderate amount of moisture, will be air brought up at C after travelling over a wide expanse of ocean, and is thus fully charged with moisture. On the other hand, opposition by c to the return current at b may mean that the BAab circulation will not persist so long after sunset, as if it had been the only movement in action.

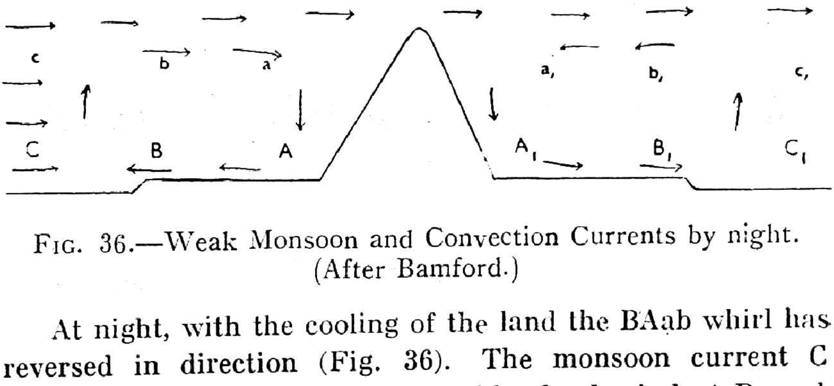


FIG. 36.—Weak Monsoon and Convection Currents by night. (After Bamford.)

At night, with the cooling of the land the BAab whirl has reversed in direction (Fig. 36). The monsoon current C thus meets the opposition of a colder land wind at B, and will be forced up and thus give rain in the early hours of the morning. Another reason for early morning rain at the coast, is that convection takes place over the sea only by night, and forms rain clouds by early morning. During April and May the incipient monsoon winds carry the rain clouds across the south-west coast, causing showers about dawn.

Recent studies seem to indicate that the south-west monsoon sets in over Ceylon in two phases: (1) a preliminary shallow phase in April, not extending over 7,000 feet in height, and rarely capable of surmounting the Central

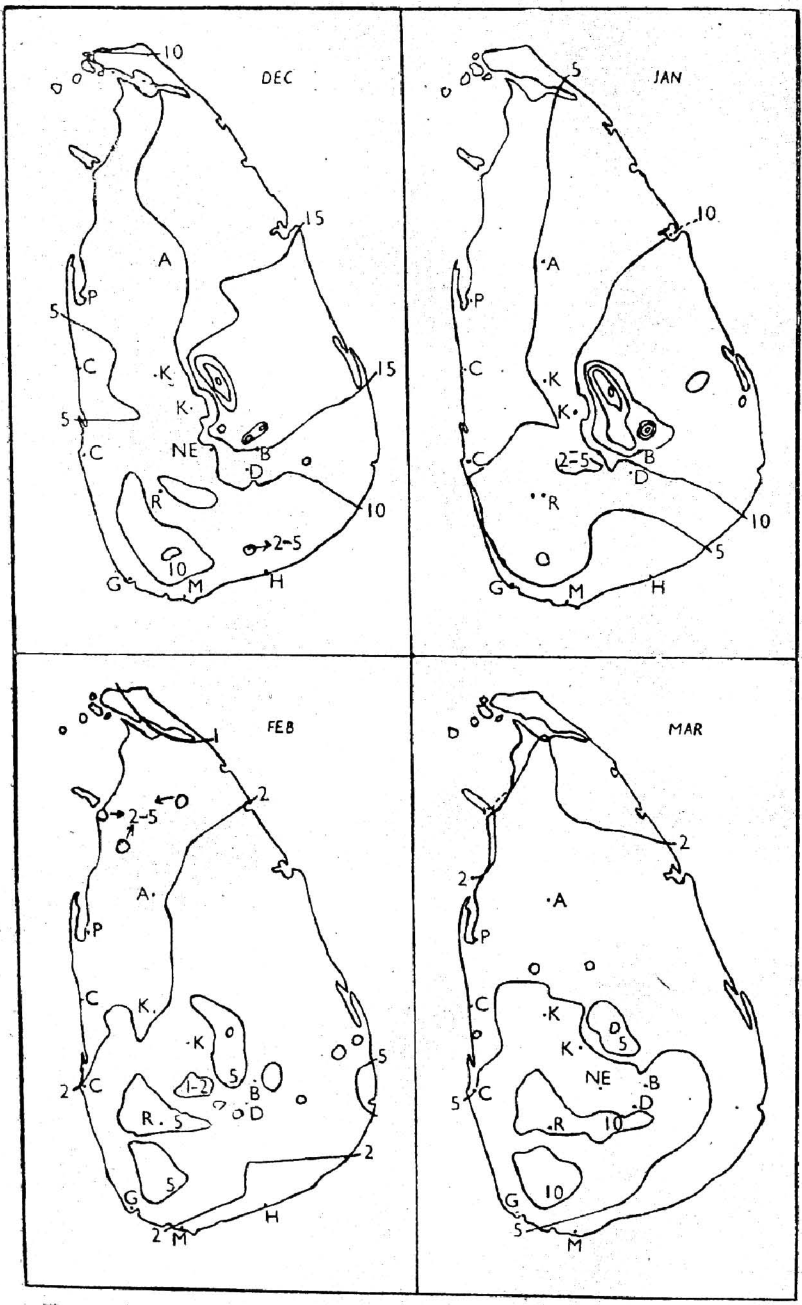


FIG. 37.—Average Monthly Rainfall, December-March.

Hills. This used to be called the 'little monsoon'. (2) The deep phase or monsoon proper, which sets in somewhere between 10th May and 10th June, and is accompanied by a drop in the diurnal range of temperature at Nuwara Eliya to less than 10°F.

While in May the monsoon current is weak enough to stagnate over the lowlands and rise there by convection, in June and July it has deepened, and is strong enough to blow across the plain, rising only when it reaches the central hill country. Thus the rainfall of exposed hill stations like Watawala and Hatton is greater in June or July than in May.[1] On the leeward side the monsoon wind, now deprived of its moisture, descends, becoming warmer and drier in the process (Chinook effect, p. 48).

The North-East Monsoon. Almost the same considerations apply to the N.E. Monsoon, with the windward and leeward sides reversed. But there are some important differences:

(1) The N.E. Monsoon being merely the north-east trade wind is not so great a rain bringer as the S.W. Monsoon.

(2) The winds, unlike those of the S.W. Monsoon, have crossed only a small stretch of sea, and therefore their moisture content is not as great.

(3) The barometric gradient is not so steep, the maximum average pressure difference between Trincomalee and Colombo being not even as much as 1.0 mb. for any month, while it is more than 3.0 mb. during the S.W. Monsoon.

(4) Perhaps for this reason it causes more widespread rain than the S.W. Monsoon, whose rainfall is somewhat confined to the south-west quadrant of the Island.

(5) It is of shorter duration—less than four months, December to March.

[1] Similarly, during the N.E. Monsoon, stations in the Knuckles Hills have a greater rainfall in January, while the Batticaloa coast has a December maximum.

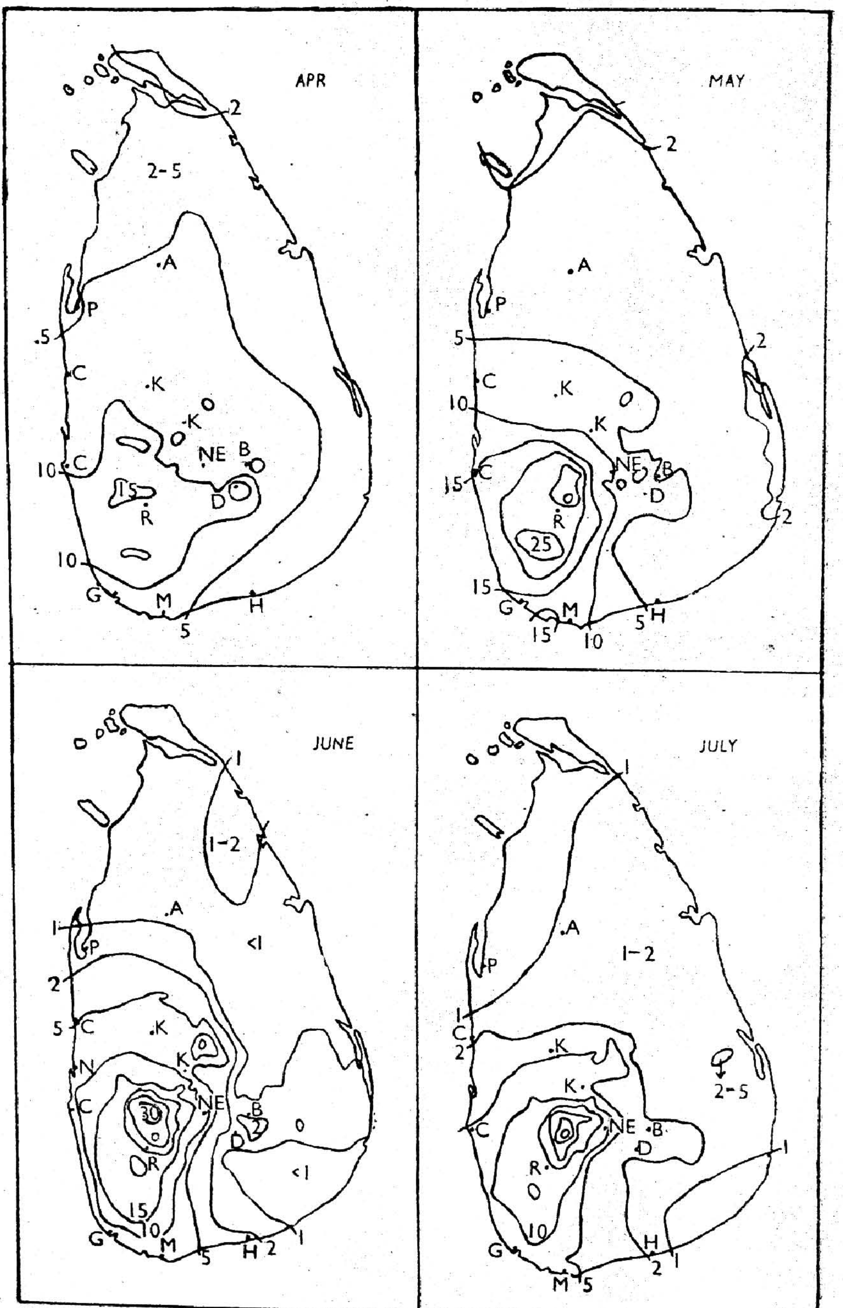


FIG. 38.—Average Monthly Rainfall, April-July.

We shall now examine the distribution of rainfall month by month. We shall commence with the inter-monsoonal month of April. No part has an average of more than twenty inches, and yet more than half the Island gets over five inches of rain, which shows the power of inter-monsoon conditions to give moderate widespread rain, whenever the absence of a definite monsoon gradient gives them the opportunity.

May shows very clearly the early development of monsoon conditions. The area getting over 5″ is much smaller than in April; two appreciable areas get over 25″, while one station gets over 30″. The way in which the 15″ isohyet extends from the west coast to the windward slopes of the central hills shows that the weak monsoon is forced to rise and thus give rain even over the coastal lowlands, owing to the effect of increased surface friction and convection over the land.

In June the extent of the area getting over 5″ is further reduced. The area getting over 15″ shows a distinct movement inland, while the south-west coastal belt gets less than 10″. This is because, while the weaker monsoon current of May found the coastal opposition sufficient to make it rise, the stronger current of the developed monsoon is able to pass this barrier with little effect, and carry its moisture further inland, till it meets the stiffer opposition of the main mass of the hill country. Here unlike in May quite an appreciable area gets over 30″. The rain, where it does occur, is more concentrated, and the rain shadow effect on the lee side more clearly marked.

In July there is a general diminution of rain, and the rain shadow effect on the east is not so marked. The diminution of rain, in spite of the fact that the monsoon current is just as strong, is probably due to the fact that when the monsoon is well established, it runs in regular stream lines, and its course is therefore not so readily disturbed as when it is

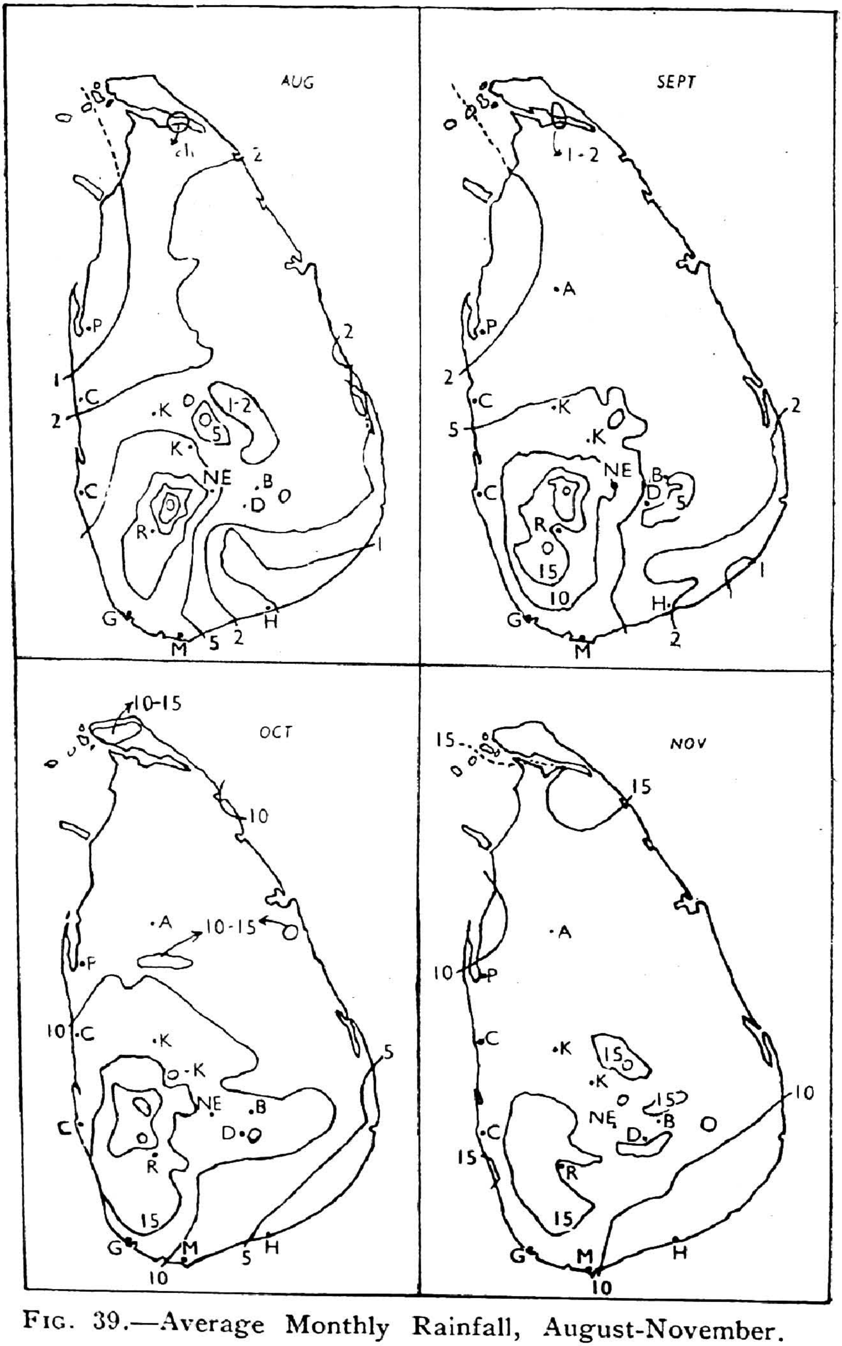


FIG. 39.—Average Monthly Rainfall, August-November.

more irregular. That is, it makes its way round the obstacle of the hills, and thus avoids rising over them.

August and September show a continuation of this effect, with a gradual increase of rain in the east and north.

October is sometimes erroneously described as a north-east monsoon month, but comparison of the map with that of May, as well as a consideration of the monsoon gradient, will show that the first half of the month belongs rather to the south-west monsoon, with some thunderstorm activity in the east and north. Though October has rather more widespread rain than May, there is a good deal of similarity in the distribution. Thus the shape of the 10″ isohyet of October is somewhat similar to that of the 5″ isohyet of May. Depressional activity is occasionally present, and is responsible for the greater rainfall in the north and east as compared with May. On the other hand, no station has an average of over 30″. The second half of October falls into the inter-monsoon period, the rainfall distribution of which is best illustrated by the map for November.

November is a most interesting month, with rainfall most widespread. For the Island as a whole, it may be considered as the wettest month, as no station gets under 5″. As many as three causes may combine to bring about this state of affairs. The first half of the month continues the inter-monsoon conditions of late October. Being the month most favoured by cyclonic depressions, the routine of bright mornings followed by afternoon thunderstorms may be broken by continuous rain for a few days in succession, more especially in the north and east. The last third of the month, more often than not, ushers in the north-east monsoon. Thus we have fairly heavy rainfall both in the south-western and north-eastern parts of the Island in this month.

By the middle of December the north-east monsoon is definitely in control. The area over 15″ is now chiefly over the eastern lowlands between Trincomalee and Kalmunai,

and extends inland to include the windward slopes of the central hills, where several stations get over 25″.

In January the monsoon has gained in strength, and the area over 15″ shows a distinct movement inland (cf. June). The rain, where it does occur, is heavier and more vigorous, while on the lee side (Sabaragamuwa and Adam's Peak ridges) it is much less.

February is the driest month of the whole year. Though the barometric gradient has not changed much, the direction of the wind on the east coast is less regular. Barring a very small area in the Knuckles Hills which gets slightly over 10″, it is not possible to say from the rainfall distribution alone which monsoon is in action, so evenly is the rainfall distributed on either side of the Island.

By March the monsoon has weakened to permit of convectional circulation on the south-western side, causing a little more rain there than in February. By April the monsoonal gradient is completely reversed. The circulation on both sides is, however, convectional, with a reinforcement of the moisture supply in the south-west (see pp. 56-7).

AVERAGE MONTHLY RAINFALL IN INCHES 1911–1940

Station	J	F	M	A	M	J	J	A	S	O	N	D	Total
Watawala, 3,260 ft. ...	5·0	3·5	7·2	11·1	25·7	38·7	29·3	25·8	25·3	24·0	15·4	7·3	218·6
Luccombe, 3,600 ft. ...	3·9	2·3	6·2	8·9	19·2	26·4	25·1	19·4	16·8	16·9	11·8	6·0	162·8
Nanu Oya, 5,342 ft. ...	5·2	1·8	4·1	5·4	10·3	14·9	13·9	11·4	10·7	10·9	8·9	6·3	103·7
S. Coombs Est. Talawakele, 4,500 ft. ...	3·8	2·0	4·7	6·3	9·5	13·3	13·3	10·1	9·8	10·1	8·5	5·2	96·3
Hatton 4,402 ft. ...	4·5	2·7	6·6	9·1	14·8	21·4	21·4	15·5	13·4	13·8	11·0	5·9	140·1
Vakaneri ...	13·1	4·2	3·1	2·8	2·4	0·8	1·2	2·0	2·8	8·3	13·2	17·9	71·7
Batticaloa ...	12·9	4·2	3·5	2·3	1·8	0·9	1·0	2·0	2·4	7·2	13·9	17·0	69·1
Amparai ...	14·1	4·9	3·8	3·5	3·5	1·7	1·8	2·9	3·6	7·1	11·0	14·4	72·4

AVERAGE MONTHLY RAINFALL IN INCHES 1911–1940—(*contd.*)

Station	J	F	M	A	M	J	J	A	S	O	N	D	Total
Panama ...	12·1	4·6	4·2	3·1	2·0	0·	0·8	1·6	1·9	5·0	9·7	10·3	55·7
Hendon, 3,860 ft. ...	40·0	12·0	11·0	11·6	6·6	3·3	3·3	3·6	6·4	17·2	24·3	37·5	176·7
S. Martin's, 3,800 ft. ...	40·0	11·0	9·7	10·8	6·5	4·4	4·1	3·9	6·2	17·1	22·9	36·8	173·4
Colombo ...	4·0	2·6	4·7	9·1	15·5	8·7	5·5	4·0	6·8	13·7	13·1	5·6	93·2
Kalutara ...	4·8	3·6	6·5	12·4	17·7	9·3	7·3	5·1	9·2	14·4	15·4	7·1	112·6
Galle ...	3·9	3·3	5·3	8·7	12·7	8·4	6·3	6·1	8·8	12·0	12·0	7·8	95·5
Matara ...	2·7	1·9	3·8	5·6	10·6	7·7	5·2	5·7	7·2	9·7	10·1	6·6	77·1
Ratnapura ...	6·3	5·3	10·4	11·6	20·9	18·6	12·8	11·4	14·5	18·0	14·8	9·1	153·6
Carney, 1,000 ft. ...	8·3	6·6	14·0	17·3	32·5	30·6	21·4	19·9	22·9	25·9	18·6	10·9	228·8
N'Eliya ...	7·0	2·0	4·1	5·0	8·5	10·4	11·0	7·5	8·2	9·8	9·2	7·8	90·4
Watagoda, 4,402 ft. ...	5·2	2·1	5·6	8·0	11·5	16·7	16·7	12·4	12·2	12·8	10·7	7·2	121·2
Kandy ...	6·3	2·3	5·8	6·5	7·6	8·8	7·3	5·7	6·1	10·5	11·0	8·4	86·9
Matale, 1,210 ft. ...	8·2	2·6	4·5	6·8	6·6	6·3	5·1	4·2	5·2	11·9	11·4	8·7	81·2
Kurunegala .	5·1	2·0	6·3	9·9	7·6	6·8	3·9	3·6	5·6	14·9	12·4	6·8	84·7
Negombo ...	2·9	·0	4·8	8·1	10·9	6·8	4·0	2·9	5·3	12·0	12·8	4·9	77·4
Haputale, 4,880 ft. ...	8·5	3·3	8·1	9·7	6·1	1·7	2·1	2·9	6·2	12·2	13·9	11·1	85·8
Passara, 2,800 ft. ...	10·0	3·3	6·9	9·9	5·8	2·9	2·7	5·2	5·2	10·7	12·7	10·4	85·7
Badulla ...	10·3	3·2	5·0	7·0	4·7	1·5	2·2	3·2	4·5	8·9	10·2	11·2	72·0
Hakgala, 5,581 ft. ...	12·4	4·1	6·3	7·0	8·5	6·6	6·6	5·2	6·7	11·3	12·3	13·0	99·9
Minneriya ...	12·5	3·2	3·7	6·3	3·4	0·4	0·9	2·3	3·6	9·0	13·4	15·3	74·0
Kalkudah ...	13·8	4·3	3·7	2·3	2·8	0·4	1·8	2·4	2·8	8·2	11·7	18·6	72·8
Yala ...	6·0	1·6	3·6	2·8	2·3	0·4	0·9	0·4	0·8	3·7	6·8	7·1	36·3
H'tota ...	4·0	1·5	3·4	3·9	4·3	2·1	2·0	1·4	2·8	4·8	7·6	5·6	43·2
D'lawa ...	6·6	2·4	4·9	6·5	6·1	2·0	2·0	3·1	4·4	9·2	10·4	8·1	65·6
Maho ...	4·7	1·9	5·8	7·0	4·5	3·2	1·9	1·6	2·9	9·9	10·6	5·2	59·0
Chilaw ...	3·1	1·4	4·2	6·1	7·1	3·3	1·8	1·4	2·9	9·4	10·2	4·5	55·6
Puttalam ...	3·4	1·4	3·1	4·9	3·8	1·4	1·0	0·6	1·6	7·4	10·1	5·6	44·3
A'pura ...	5·8	1·7	4·2	6·4	3·5	0·7	1·3	1·6	3·8	9·7	10·7	7·5	57·0
Trincomalee.	8·3	2·6	·3	2·2	3·2	0·9	1·7	3·6	3·4	9·6	13·9	13·0	64·8
Jaffna ...	4·4	1·5	1·6	2·2	2·0	0·4	0·6	1·1	2·5	9·2	17·3	10·4	53·1
Mannar ...	3·8	1·7	1·8	3·4	1·8	0·4	0·4	0·7	1·2	6·6	10·2	7·8	39·8
Milapitiya, 1,710 ft. ...	7·0	2·2	4·3	5·6	4·5	2·4	2·9	1·9	3·5	7·5	9·4	7·8	59·0
Rajawella, 1,500 ft. ...	7·2	2·3	4·7	5·7	5·0	3·9	3·8	2·8	3·8	8·8	8·9	8·1	65·0

In the above table stations showing the same periodicity of rainfall (or rainfall regime) are grouped together. The student should use these figures to draw graphs to illustrate each type of regime. The map (Fig. 40) shows a division of Ceylon into regions of differing rainfall regime.

Region 1. Only a small triangular area with apices roughly at Watawala, Adam's Peak and Nanu Oya may be described as showing a definite S. W. Monsoon regime, with a single maximum occurring at the height of the south-west monsoon. The rainfall of Watawala illustrates this type of regime very well. It is not hereby intended to imply that convectional and cyclonic air movements make no contribution to the rainfall here, but that the rainfall due to the S.W. Monsoon is great enough to mask the effects of convection and depressions. In the other stations included in this group, there is a tendency for the effects of convectional circulation to become evident in a slight rise in the rainfall during September-October, but as it amounts only to a few tenths of an inch, it may be ignored.

Region 2. Batticaloa and a strip of the east coast show a typical N.E. Monsoon regime, with a single maximum occurring during the N.E. Monsoon. Two stations on the eastern face of the hill-country show an approach to this regime, except for a slight rise in the rainfall of April.

Region 3. All other stations show the equatorial regime with two maxima characteristic of equatorial regions in other parts of the world. The south-western part of the Island is typically equatorial, the two maxima being of comparable size, and occurring during the S.W. Monsoon, i.e. May-October. This may be described as an equatorial regime with S.W. Monsoon influence predominating (Equatorial Wet Zone).

Region 4. Stations in the north, south, and east of the Island also have two maxima, but the earlier maximum is insignificant, so that the two drier seasons combine to form

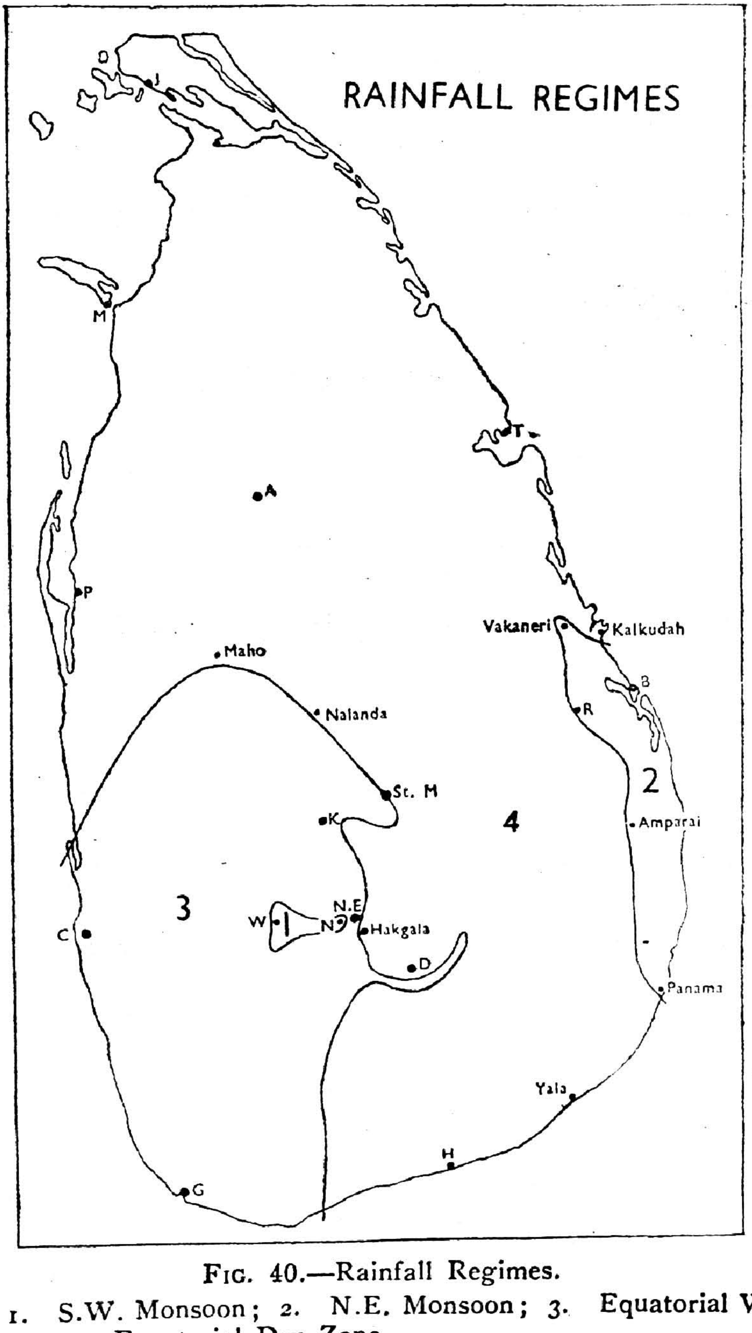


FIG. 40.—Rainfall Regimes.

1. S.W. Monsoon; 2. N.E. Monsoon; 3. Equatorial Wet Zone; 4. Equatorial Dry Zone.

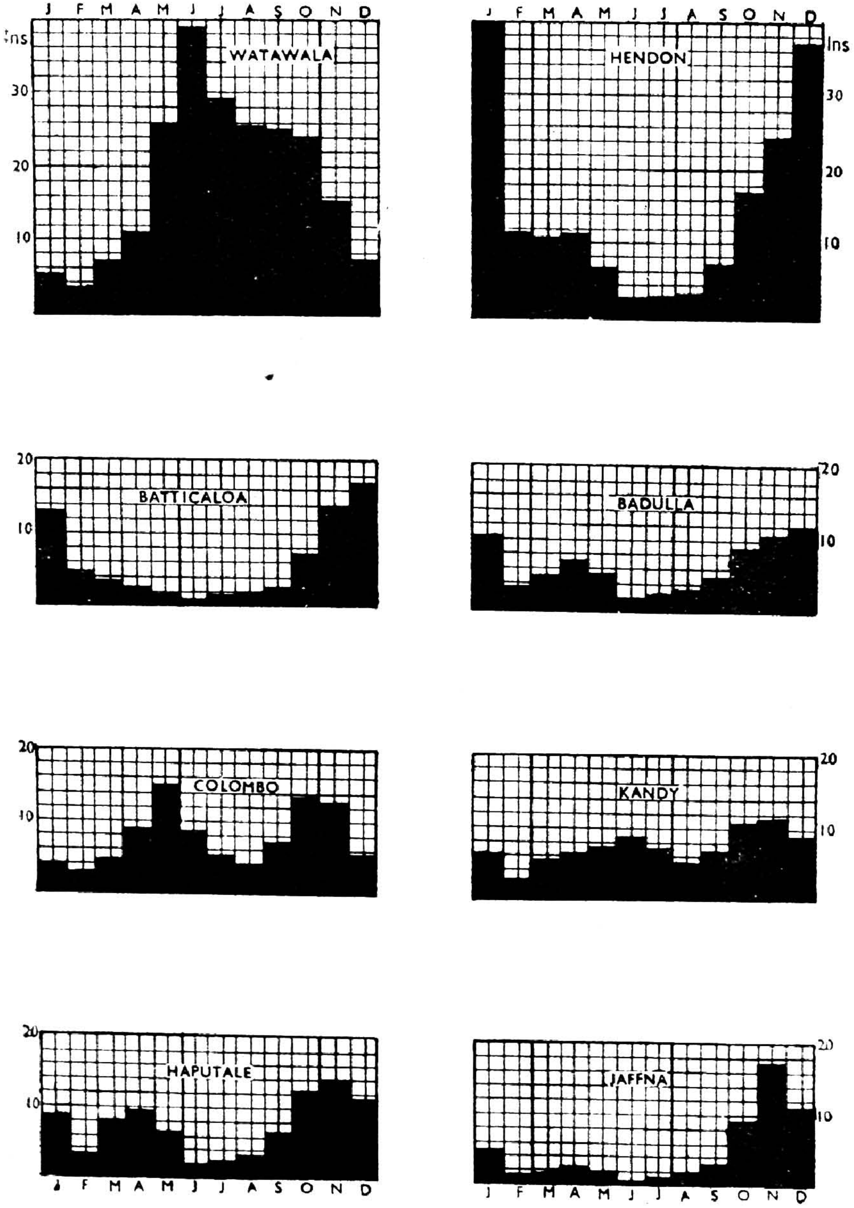


FIG. 41.—Rainfall Graphs.

a single season of prolonged drought lasting about six months (Equatorial Dry Zone).

EXERCISES

1. What factors appear to govern the regional distribution of rainfall in Ceylon?
2. Describe the distribution and characteristics of the rainfall during the South-West Monsoon.
3. Under what conditions does convectional rain fall in Ceylon? Describe its characteristics.
4. What effect has the passage of depressions on the distribution of rainfall in Ceylon?

CHAPTER 7

NATURAL VEGETATION

The natural vegetation of Ceylon is determined mainly by the rainfall, and to a less extent by such factors as temperature, soil and past interference by man. Most of the natural vegetation cover may be described as forest, but there occur here and there a few areas of grassland. We may divide the forests into four groups:

(1) The low-country wet zone or true equatorial forest,
(2) The montane zone forest,
(3) The thorn jungle or arid zone scrubland,
(4) The low-country dry zone forest.

Of the grasslands we may distinguish at least two groups:

(1) The patanas or montane grasslands,
(2) The savannah or low-country grasslands, variously known as the talawas, damanas, etc.

The low-country wet zone forest occupies the south-western quadrant of the Island, which has a rainfall of over 80″ and no marked dry season. It is most luxuriant within the 150″ isohyet. This forest is characterised by tiers of trees of different heights. The tallest of these reach a height of 150 to 250 feet, and stand with their crowns high above the dense canopy of the other trees below them. Between the dominant tier and the dense undergrowth which occupies the forest floor are several other tiers of less height and progressively greater shade-enduring capacity. The trees are predominantly evergreen and covered by lianas and creepers of every kind, which make the forest most difficult to penetrate. The trees are mainly soft woods, but include a few moderately hard woods. Many of these forests have

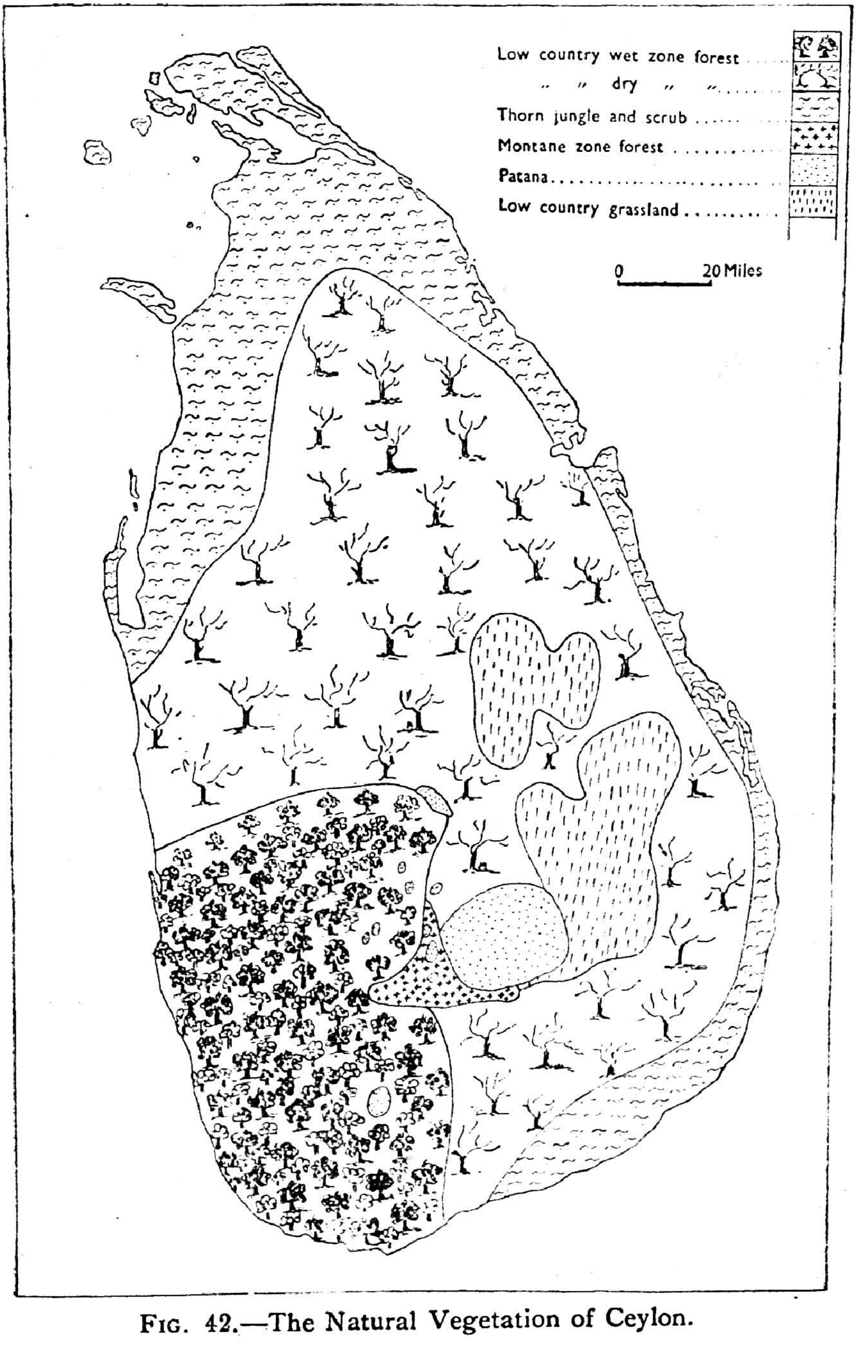


FIG. 42.—The Natural Vegetation of Ceylon.

now been cleared, originally for coffee and cinchona, and later for tea and rubber cultivation; and hence they occur in isolated patches, occupying only about one per cent of the land area in most parts. The largest tract of virgin forest still left is the Sinharaja forest, occupying south-western Sabaragamuwa and the adjoining parts of the Galle and Kalutara Districts. The principal trees of the wet zone forests are hora, aridda, dun, kina, del (breadfruit), kos (jak), godapara, lunumidella and milla. Of these, jak yields the most useful timber. Nadun and calamander (kalu-mediriya) yielded valuable cabinet woods, but are becoming increasingly scarce. Other important trees native to this region are cinnamon, arecanut and kitul, but they are hardly found in the wild state. One of the difficulties in the exploitation of these timbers is that the different kinds are widely scattered among species of little economic value, hora and aridda being the only trees that occur gregariously. Exploitation, which is carried out now only by the Forest Department, is being done on the basis of inducing and promoting natural regeneration of timber species of economic value. This is done by cutting of climbers and girdling of inferior species so as to give more space and light for the better trees to develop. Artificial plantations have also been established, mainly of jak and mahogany, but also of other species, such as nadun and lunumidella. The low-country wet zone forest persists up to elevations of about 3,500 feet.

Above this elevation occurs the *montane zone forest*, the trees of which are generally shorter, much branched, provided with thick bark and generally adapted to drought. The forest is single storeyed and of even height, but there is plentiful undergrowth, while orchids and ferns become abundant. Few of the trees are of value for timber. The chief of these are kina, dambu, mihiriya and sapu. This forest is confined to the ridges and higher slopes, as the land was indiscriminately cleared for coffee, cinchona and

tea until 1873, when the protective value of this forest was realised. It was then decreed that the remaining forests above the elevation of 5,000 feet should be left intact. They comprise only about 100,000 acres, and occur mainly in the Adam's Peak and Pidurutalagala ranges.

The thorn jungle or arid zone scrubland occurs mostly within the 50″ isohyet, in the north-western and south-eastern parts, but also outside it, as in the limestone region of the Northern Province, and in other parts of the east coast, where the soil is very sandy, and where the sea winds exercise a desiccating effect. The vegetation cover is rather scanty, and consists of close clumps of small trees and thorny bushes. The tree element is stunted, much branched and twisted, often covered with spines, the leaves are small or absent, all indicating an adaptation to drought. The chief species are wira, gurukina, karamba, kukuruman and katuniyanda: various species of Acacia like the umbrella tree, cockspur thorn (S. gini-andara) and elephant thorn (T. Anaimulli), thorny climbers like *Toddalia asiatica,* and cactus-like plants like the prickly pear and *Euphorbia antiquorum.* The palmyra palm grows well here, but the coconut survives with difficulty.

The dry zone forest occupies the lowlands between the arid zone scrubland and the wet zone forest, covering about 2.25 million acres in all. Here the mean annual rainfall is anything between 50 and 100 inches. The main characteristic, however, is not so much the quantity of rainfall, but the four month period of drought during the S.W. Monsoon, when several of the trees shed their leaves and undergo a period of rest. The trees of this forest are not so tall as those of the wet zone, the dominant canopy being about sixty feet high, and there are no trees emerging very much above this general level as in the wet zone. The trees are mainly hardwoods, and it is from this forest that the most valuable timbers are obtained, such as ebony, satinwood, halmilla.

palu, weveranai and na, while milla, which occurs in the wet zone as well, is at its best in the dry zone. Among the deciduous species are satinwood, milla and halmilla. The evergreens include ebony, palu, weveranai, etamba and wira, the last being the most widespread. It forms the forest matrix amongst which the other tree species occur scattered here and there. The general character of the forest is thus evergreen, and it is sometimes described as the Dry Mixed Evergreen Forest. The dry zone timbers are not generally found above an elevation of 1,500 feet, but certain species are found at higher elevations, e.g. ebony up to 4,000 feet, and milla up to 3,000 feet.

The best forests of the dry zone contain only about one exploitable tree for every two or three acres, and the average tree yields only thirty cubic feet of utilizable timber.

Natural regeneration in the dry and montane zones is more difficult than in the wet zone. Improvement has been largely through actual planting. In the dry zone about 10,000 acres of teak plantations have been established. In the montane zone mixed plantations of Monterey cypress and various species of eucalyptus have been set up.

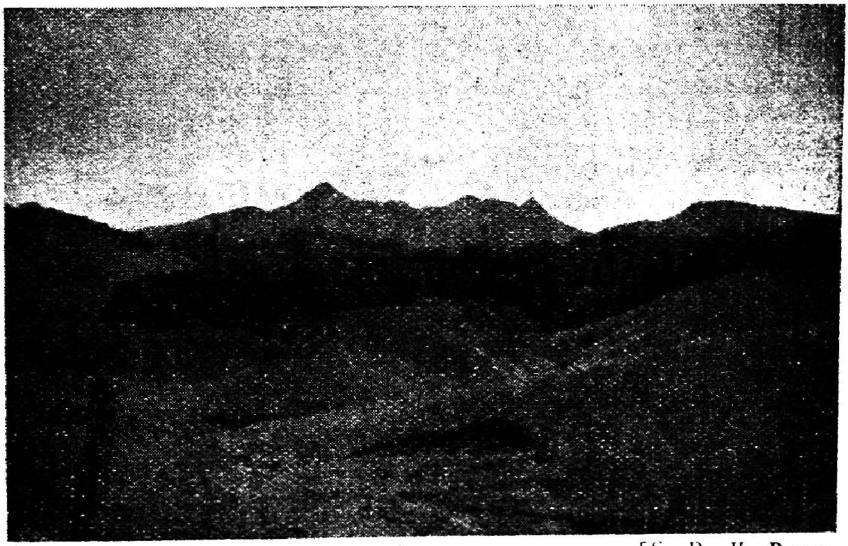
Ceylon's forests, if carefully controlled and replanted, can supply only a portion of her needs. There is not enough timber to permit large scale industrial consumption of wood fuel, or even railroad operation on firewood.

The *patanas* or montane grasslands cover about 250 square miles and fall into two groups: (1) wet patana—25 square miles, (2) dry patana—225 square miles.

The wet patanas occur mainly on the summits and western faces of the Piduru-Totupola range. They include the Horton Plains (5,000 acres), Elk plains (3,000 acres), Bopatalawa-Agrapatana (2,500 acres), and Sita Eliya-Moon Plains (1,500 acres). These are mostly at altitudes above 5,000 feet. The native grasses are tufted, coarse and wiry, and in areas which have escaped burning for a long period,

often reach up to three feet in height. The only tree species is the rhododendron, which has a stunted and gnarled habit.

Most of the wet patanas occur either on flat stretches of high plateau like the Horton Plains, or in valley bottom sites where conditions favour the formation of marsh. Soil and drainage conditions discouraged the spread of forest in such locations.



[*S. D. V. Perera*

FIG. 43.—Wet Patana with tongue of Montane Forest. View from Bopatalawa eastwards. Totupola, Horton Plains and Kirigalpota in background.

The dry patanas occur mainly in the province of Uva and in a region which has less than 20″ of rainfall during the period May-September. Unlike the wet patanas they occur at elevations ranging from 2,500 to 5,000 feet. The vegetation consists mainly of short grasses closely cropped by the grazing of cattle, and often periodically burnt. The subsoil is usually dry, and during periods of drought the soil is

hard and difficult to work. Patches of forest occur on moister sites, especially in the valleys and ravines which are associated with the watercourses.

Though the climatic conditions of the patana seem to be unfavourable to indigenous trees, introduced species seem better able to withstand the effect of both drought and wind, and the government has embarked on a policy of afforesta-

[*B. H. Farmer*

FIG. 44.—Damana Country, Tamankaduwa.

tion of the patana with various species of eucalyptus from Australia, and also of Acacia (wattle). Apart from the use of the timber for fuel in a treeless region, these plantations serve as shelter belts under the shade of which, vegetables and fruits and other supplementary food crops may be raised.

Isolated patches of similar patana are also found to the west of the central divide in the area lying between the

middle Mahaweli Ganga (from Nawalapitiya to Kandy) and a line joining Watawala to Ramboda and Hewaheta. The Bulutota-Rakwana Hills and the Knuckles Hills are also patana covered in parts. These grasslands seem to be of more recent origin than those of the Uva Basin, and it has been suggested that they mark the sites of old abandoned coffee estates.

[*K. Jesudian*

FIG. 45.—Villu Grassland, Batticaloa District.

The *savannah grasslands* occur below an elevation of 2,000 feet in the eastern and south-eastern piedmont regions of the Central Highlands, and are distinguished from the patanas by the fact that they have a considerable number of trees scattered here and there, which give them a park-like appearance. They occur mainly in the upper basins of the Mundeni Aru, Gal Oya, Kumbukkan Oya, Menik Ganga and Kirindi Oya. They seem to be permanent grasslands subject to periodical fires, with a scattered tree element of

fire-resistant species, the commonest of which are Aralu, Bullu, Nelli and Dawu. They have been variously called talawas, damanas and savannah forests. The tussock grasses which cover their floor are burnt periodically by herdsmen, but in areas which have escaped fire for some time, the grasses may reach five feet in height.

Another kind of grassland found generally at elevations below 500 feet, and mainly in the Eastern Province and adjacent fringes of the Uva and North-Central Provinces, are the wet villu grasslands. These occur sporadically in permanently moist sites around abandoned tanks, large water-holes or river banks.

Some of the damana and villu grasslands, particularly in the Tamankaduwa Division of the North-Central Province, have been reputed for grazing, and are much used by the Muslim peasants of the area for fattening their cattle for the market.

We may summarise the causes predisposing to the occurrence of grasslands as follows:

(1) Deforestation,

(2) Spread of fires,

(3) Lower rainfall and a pronounced dry season,

(4) Prevalence of desiccating winds during May-August,

(5) Thinness of soil cover, and

(6) Lack of proper drainage.

EXERCISES

1. Describe and account for the distribution of natural vegetation in Ceylon.

2. Into what groups would you divide the grasslands of Ceylon? Describe the characteristics and distribution of each group.

3. Compare and contrast the nature, distribution and possible economic importance of the wet zone and dry zone forests of the low country.

CHAPTER 8

SOILS

Soil is rock-derived material in which the mineral constituents are altered by decomposition and mixed with organic matter in various stages of decay. This organic matter is known as humus.

The common minerals of rock and soil are the silicates and hydrated oxides of aluminium and iron together with quartz. There are also small but important amounts of compounds of calcium, magnesium, potassium, etc.

In order of coarseness, i.e. size of particles, the mineral constituents of soils are gravel, sand, silt and clay. In sand, the particles are sufficiently large to be visible to the naked eye, and in clay the particles are less than .002 mm., i.e. they are so small as to be individually invisible to the naked eye. In any sample of soil all these will be mixed, but generally speaking, a sandy soil may be defined as one having less than 20% of silt and clay particles, and a clayey soil as one having over 60% clay, whereas a soil having sand and clay in roughly equal proportions is called a loam.

Of all the constituents of soil, the most characteristic are the clay and the humus. A fair amount of gravel and sand is necessary to ensure good drainage. Silt is very useful for maintaining even conditions of moisture in the soil.

Clay belongs to the class of substances known as colloids. Its most characteristic property is that when well mixed with water, it swells, becomes sticky and plastic, and impervious to air and water. On subsequent drying it shrinks and sets very hard. The movement of water in the soil is to a great extent dependent on the clay content. Like all colloids, clay has also the property of absorbing

the constituents of salts in solution. The proportion of clay in a soil thus indicates both the water-holding capacity and potential fertility of that soil. But a water-holding soil will tend to be a cold soil, and one that is insufficiently aerated; hence extreme clay soils though rich in plant food, will be heavy to work and cold, while coarser soils like sands will be poor in food, but light, warm and open.

Humus gives to soil certain characteristic properties. It increases the water-holding capacity of the soil, improves its physical condition, and renders cultivation easier. It also gives to soil a dark brown or black colour, and like clay it absorbs the constituents of salts in solution.

Soil may be defined as the mantle of rock-waste in which the physical and chemical processes of weathering co-operate in intimate association with biological processes, such as the accumulation of organic matter, the action of bacteria, the working down of roots and rootlets, the activities of earthworms and the burrowing of animals. All these processes depend on climate, thus making the latter a major factor in the determination of soils. But, other factors are also involved, especially the nature of the bedrock or parent material from which the soil is derived, the relief or topography of the land, the length of time during which the soil has been developing, and the effects of cultivation. It would seem that in any particular case, any factor developed to its maximum becomes dominant over other factors. In regions of excessive rainfall, climate determines the character of the soil; where subsoils are impervious, the effect of inadequate drainage may mask almost everything else; while in regions of moderate rainfall but with great variety of parent rock, the climatic effect may be surpassed by geological factors.

In any study of soil it is important to consider what is called the 'soil profile'. By this term is meant the vertical section from the basal unweathered material to the surface

soil. It is composed of layers of different appearance which, as a rule, gradually shade into each other, and have been termed 'horizons'. Where precipitation exceeds evaporation,

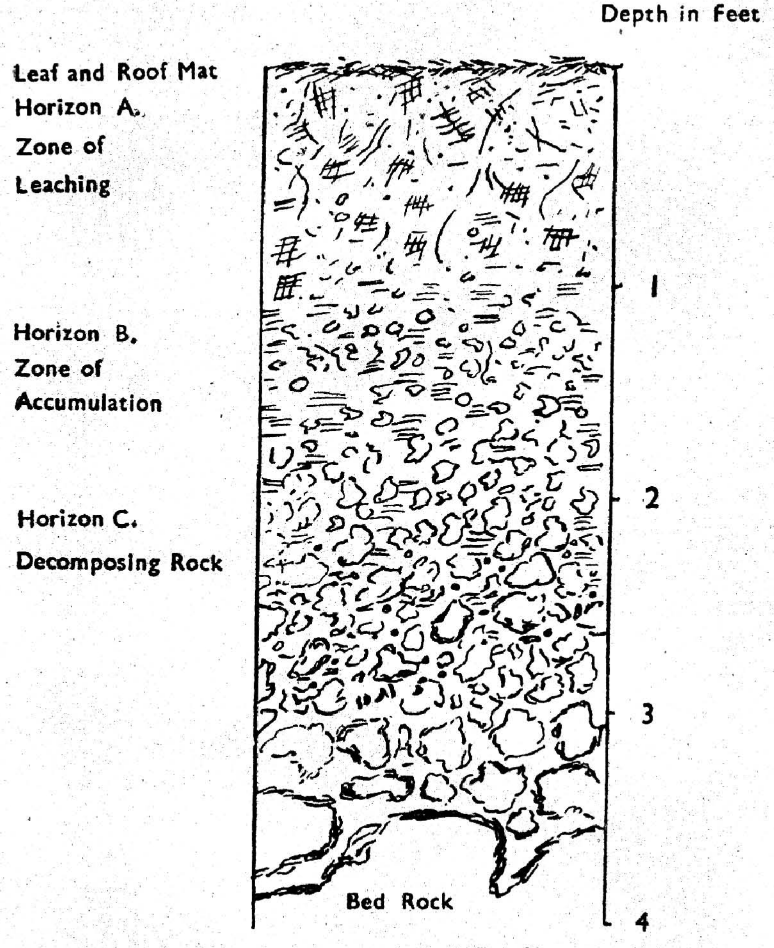


FIG. 46.—Typical Soil Profile.

the general downward percolation of water *leaches* the upper layer, i.e. washes out its soluble constituents, and deposits them in the lower layers. On the other hand, in arid climates the evaporation current is preponderant, and the

upper layers are enriched with mineral salts carried upwards from lower. This translocation of materials throughout the soil body is often revealed by changes of colour, which indicate the different horizons. The feebly soluble iron oxides with their characteristic reddish colour accumulate in the zone of arrest, and if in excess may form a hard well cemented band, impervious to drainage, and known as 'hard pan'. One of the objects of ploughing is to prevent the growth of hard pan. Otherwise the soil will become waterlogged, and there will be a marked tendency for peat to accumulate.

The uppermost layer of the soil, or zone of leaching, is known as the A horizon; the subsoil, or zone of accumulation, is referred to as the B horizon, and the unaltered rock material lower down forms the C horizon (vide Fig. 46).

Since the weathering of the parent material depends mainly on moisture and temperature, it is at a maximum in equatorial latitudes where the resultant soils are highly leached, and where there is very little accumulation of valuable humus. In the frigid zones beyond the limit of tree growth, chemical decomposition is at a minimum, and though physical weathering is rapid, the resultant soil is a jumble of shattered mineral fragments, rather than a valuable medium for plant growth.

From the typically arid zone of 30° latitude which marks the great hot deserts of the world, leaching increases both polewards and equatorwards, but differential weathering results in the removal of bases[1] and oxides from soils on the poleward side of the desert, where temperatures are moderate, and in the removal of bases and silicates on the equatorward side, where temperatures are high. Leaching which involves the removal of the oxides into the lower horizons with resultant silicate residue is known as

[1] A base is any alkaline substance capable of neutralizing acids. Bases are usually oxides or hydroxides of metals.

podsolization, while leaching at higher temperatures, which involves the destruction of the silicates leaving the oxides of iron and aluminium behind as the main residues, is known as *laterization*. The latter process gives rise to the soils known as laterites. Of the oxides, aluminium and (more commonly) iron are greatly preponderant, 'often mutually excluding each other; hence we have numerous varieties of laterite, which have bauxite (aluminium ore) at one end, and an indefinite mixture of ferric oxides at the other'.[1]

High temperature and heavy rainfall are eminently favourable to chemical weathering and the development of laterite, where the parent rock material is igneous or gneissic rock. Three horizons may be distinguished above the parent rock. The upper layer consists of a friable soil with frequent air spaces, sandy if the quartz content of the underlying rock is high, but more often clayey. Iron concretions are often mingled with this layer, and if present in large quantities, give the surface soil a gravelly appearance. The second layer—the cabook or laterite proper—is usually brick-red in colour, and clayey in texture. A soil of this type is not sticky when moist, breaks easily, and hardens and becomes compressed as it loses water and air. Hence the name laterite (from *later*, brick). The third layer is the coarser product of weathering of the parent rock, and is again friable, lacking the clayey character of the second layer, and lighter as the iron content decreases downwards.

Under equatorial conditions of constant heat and moisture, decomposition of organic matter proceeds so rapidly and completely, that the stage of production of humus quickly passes, and the soil is therefore easily depleted of this valuable constituent. Laterites accordingly lack humus and, deprived by leaching of the soluble mineral constituents of plant food, are not naturally fertile. The

[1] D. N. Wadia, Geology of India, 1939.

primeval forest by leaf fall and decay returns to the soil sufficient organic matter for its own continuance, but if the forest is cleared, and in its place crops are planted and their products removed, lateritic soils soon become exhausted.

Sometimes we find that the soil has no relation to the underlying rock, but has been brought from elsewhere by water, wind or other natural transporting agencies. Such soils as alluvium or loess are described as transported soils, as distinct from sedentary soils, which are formed *in situ* above the parent rock.

With this preliminary examination of the factors governing the formation of soils in general, we may now try to see how these factors have affected the development of the soils of the Island. For convenience, the soils of Ceylon may, according to Joachim[1], be divided into five main groups:

(1) Crystalline soils, (2) Limestone soils, (3) Humic soils, (4) Pleistocene soils, (5) Alluvial soils.

Crystalline soils. These have developed on regions of crystalline rock—the gneisses, Khondalites, charnockites and granites. They show no characteristic B horizon, and include the following soil types:

(a) *Laterites and lateritic earths* occur in the south-west quadrant of the Island where the annual rainfall is over 100″. They show a characteristic reticulated structure, are of variable depth and are usually overlain by gravelly loam. The natural vegetation cover is high forest.

(b) Lateritic loams are characteristic of the intermediate zone between the 80″ and 100″ isohyets. In these the reticulated structure is not developed.

(c) The non-lateritic red and brown loams occur where the rainfall is between 40″ and 80″, where there is less leaching, and the process of reducing the soils to

[1] The Soils of Ceylon, by A. W. R. Joachim—Bulletin of the Ceylon Geographical Society, Vol. 2, No. 1, March 1947.

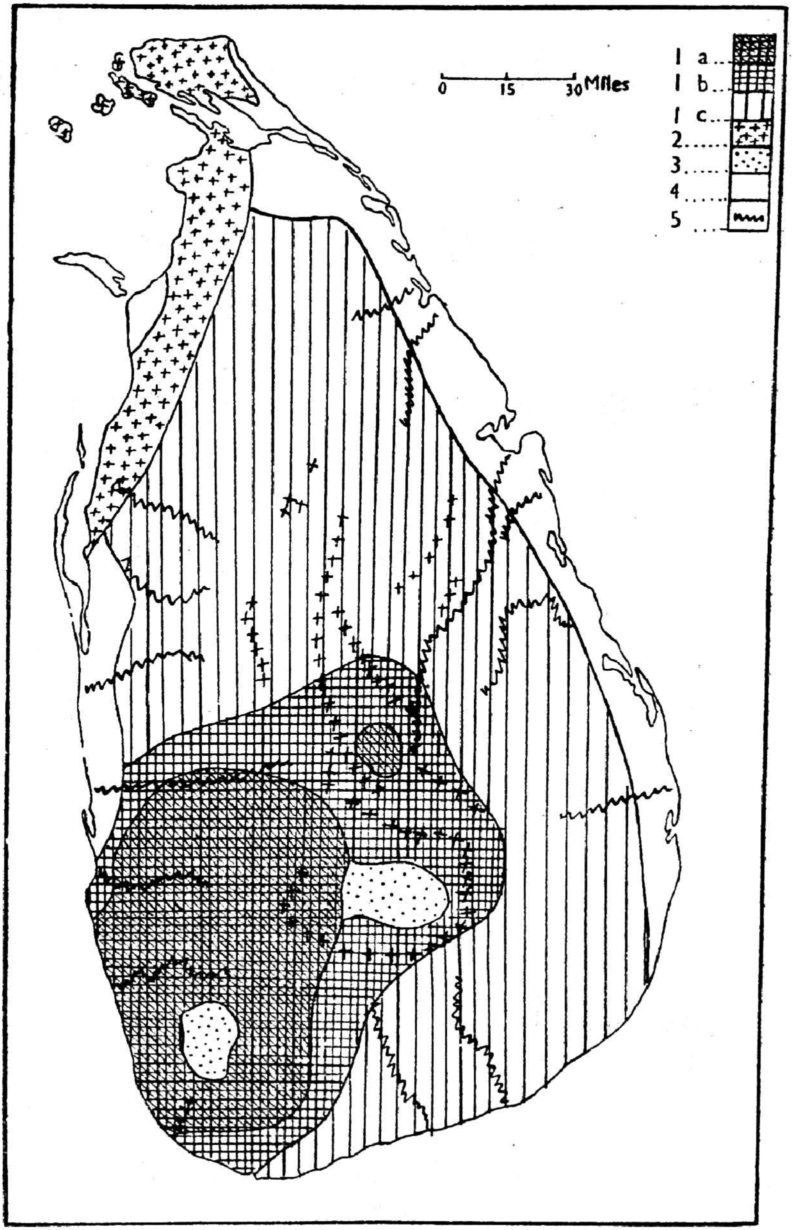


FIG. 47.—Simplified Soil Map of Ceylon. (After Joachim.)
1. (a) Laterites & lateritic earths. (b) Lateritic loams. (c) Non-lateritic loams. 2. Limestone soils. 3. Humic soils. 4. Pleistocene soils. 5. Alluvial soils.

laterites is less complete. They are found in many parts of the better drained areas of the dry zone, and are covered with high and medium forest.

(d) Where drainage is impeded, the red loams of well drained slopes give place to dark grey loams. These occur in low-lying locations. Low jungle is their natural vegetation, but occasionally damanas or park-lands occur in them.

Limestone soils. Where the parent material is calcareous, we may get (a) Red loams like the tobacco soils of the Jaffna peninsula. These are uniform in texture down to the bedrock, which occurs at a depth of 1 to 30 feet from the surface. These soils are rich in lime and minute particles of iron. The solution of the calcium carbonate leads to the oxidation of the iron salts into ferric oxide, which, being insoluble, is left behind as a residue to form a red loamy mantle on the surface. These soils are well drained and rich in bases, but poor in nitrogen and humus.

(b) Grey loams like the paddy soils of Jaffna are not only poor in nitrogen and humus, but are also of shallower depth than the red soils.

(c) Outcrops of crystalline limestone have in places given rise to brownish-red loams, e.g. at Nalanda, Matale and Ampitiya.

Humic soils occur in limited localities of imperfect drainage within areas of lateritic earths and loams. They are the result of the interaction of the vegetation as well as the climate with the bedrock. They include:

(a) The wet patana soils which have a dark brown to black acid humic surface horizon, of depth varying from one to three feet or more, overlying a gravelly layer superimposed on a mottled reddish-yellow lateritic loam.

(b) The dry patana soils have a shallower surface horizon generally less than 9″ in depth, and consisting of a gravelly loam with little organic matter. The B horizon

has a very high gravel content, giving it the appearance of a hard pan some six to twelve inches in thickness.

(c) The kekilla or fernland soils are acid humic soils occupying the wet valleys of Sabaragamuwa. The fern is a secondary growth arising from the clearing of the jungle, and the periodical burning of the succeeding vegetation.

(d) Peaty or boggy soils occupy low-lying 'deniya' lands and swampy marshes. They overlie loams, clays and sands, and are suitable for paddy cultivation. Occasionally, they are inundated with salt water from adjacent lagoons.

Soils derived from Pleistocene deposits.

(a) The red and brown sandy loams form typical coconut soils. These are found in the Puttalam-Kurunegala-Chilaw triangle, in Mannar Island and on the east coast from Elephant Pass to Pottuvil. They are generally deep, well drained, light, sandy loams with no apparent profile change, except that the surface is slightly darker in colour, owing to its higher content of organic matter. Though poor in all plant nutrients, they give good crops of coconuts when manured.

(b) The white sandy cinnamon soils are derived from the above and occur in areas of higher rainfall. They are waterlogged on account of the development of a clay humic pan about five feet below the surface, as at Jaela and elsewhere. Because of this, for the successful growth of other crops such as coconuts, drains have to be cut through this pan.

Alluvial soils are of recent formation, and are the result of well developed river systems, which carry detritus and silt from higher elevations to deposit them in low-lying valleys and flood plains. Because of their clayey nature they are mainly utilized for paddy cultivation. Many of

the residual red, brown and grey loams are also very suitable for paddy cultivation.

EXERCISES

1. What is soil? Classify soils in order of coarseness.

2. What do you understand by the term 'soil profile'? What factors determine the formation of the chief types of soil?

3. Distinguish between podsolization and laterization.

4. Describe with a sketch map the distribution of the chief soil types found in Ceylon. Explain briefly how each type has been formed.

CHAPTER 9

IRRIGATION

While Ceylon is generally considered a well-watered country, the variability of its rainfall, particularly in the dry zone, is perhaps its outstanding characteristic. The necessity for constructing great works of storage to tide over periods of drought as well as to check floods was accordingly recognized from the times of the earliest Sinhalese kings. The remains of innumerable tanks and channels are ample testimony to this fact. The development of indigenous irrigation reached its zenith in the time of Parakrama Bahu the Great in the twelfth century A.D. From that time onward till the arrival of the Dutch, and subsequently of the British, the irrigation system was allowed to fall into disrepair and decay. The restoration of the ancient works began in earnest from about the middle of the nineteenth century. Since the grant of adult franchise and the recognition of the need for making the Island self-sufficient in the matter of food production, it has proceeded apace.

In 1952 the total irrigated area was 640,000 acres. Of this area, 233,000 acres were under major irrigation schemes, and 407,000 acres under minor or village irrigation works. Though the area under minor schemes is nearly double that irrigated by major works, nevertheless village works do not bring in results commensurate with the time and energy spent on them. From the point of view of increasing the country's production of food, it is from the major schemes that beneficial results are to be expected.

The acreages irrigated by major schemes in the various Provinces are as follows:

E.P.	75,000	N.W.P.	16,000
S.P.	48,000	C.P.	15,000
N.C.P.	43,000	Uva	6,000
N.P.	29,000	Sab.	700
W.P.	300		

The respective acreages under each of the chief major schemes (Fig. 48) are:

1. Pattipolai Aru	28,000	9. Gangaboda Pattu	9,000
2. Parakrama Samudra	15,000	10. Rugam	8,000
3. Walawe Ganga	15,000	11. Nachchaduwa	7,000
4. Giant's Tank	15,000	12. Ridi Bendi Ela	7,000
5. Kalawewa	12,000	13. Mannalpuddi Aru	7,000
6. Iranamadu	10,000	14. Unnichchai	6,000
7. Minneriya	10,000	15. Vakaneri	6,000
8. Kirindi Oya	9,000	16. Kantalai	5,000
		17. Batalagodawewa	5,000

Some of these schemes are in the process of being extended, and it is proposed to increase very considerably the acreage irrigated by them by the construction of reservoirs higher up the rivers as has already been done at Inginiyagala. Other projects are the Walawe scheme near Embilipitiya, the Elahera scheme, the Minipe Yodi Ela scheme and the Minneriya augmentation scheme.

The Pattipolai Aru is a branch of the Gal Oya, which enters the sea about 30 miles south of Batticaloa. The old scheme was based on three tanks, Irakkaman, Amparai and Kondavattavan, which irrigate the largest single stretch of paddy land in Ceylon. The Gal Oya rises in the eastern borders of the hill country, and flows through a region whose rainfall is so concentrated into the four months, October-January, that these tanks are hardly adequate to

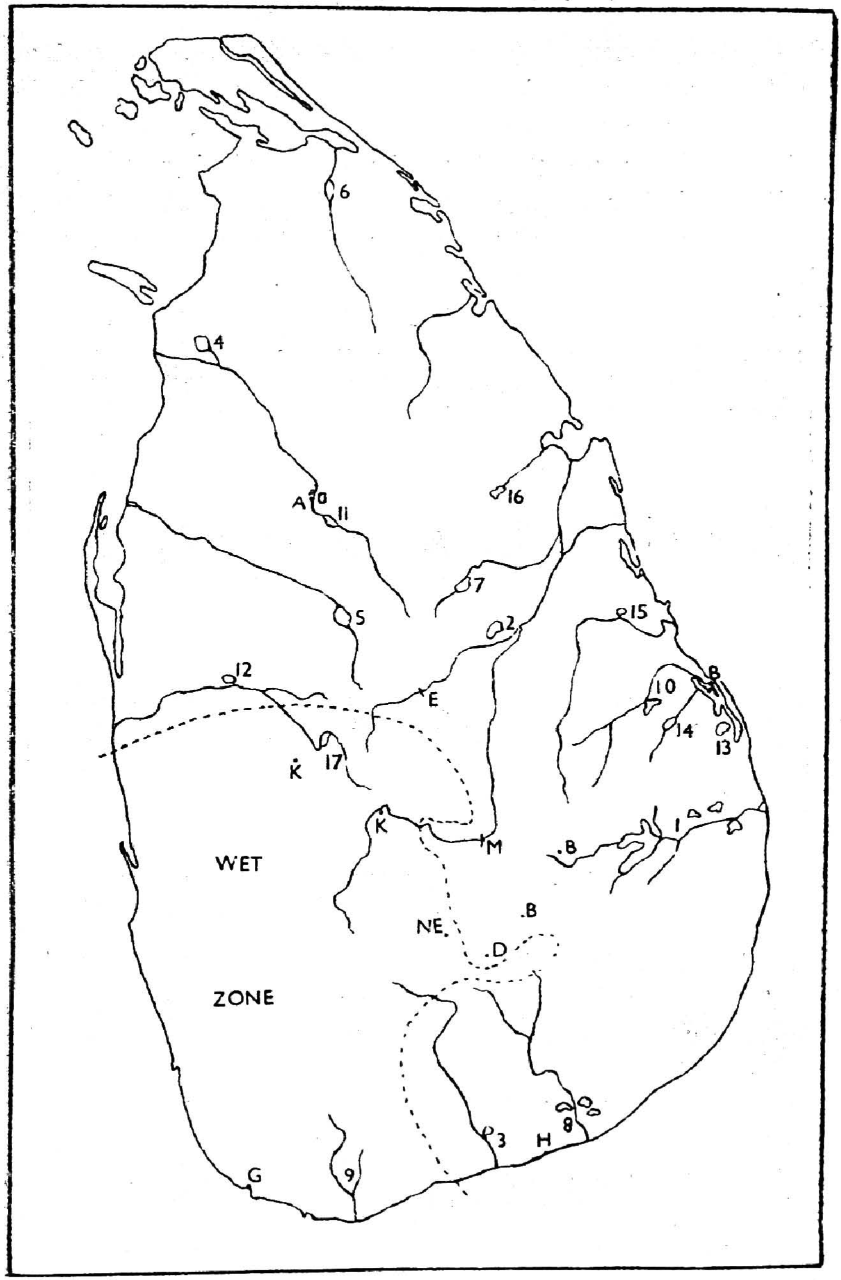


FIG. 48.—Major Irrigation schemes.
(*For numbering see p. 90.*)

check the enormous damage caused by floods. A vast area much larger than that already under cultivation is thus annually covered with a layer of fertile silt. The deposit of silt has been so great as to obstruct the river, and make it reach the sea by several distributaries. Its deltaic course seems to commence some eighteen miles from the coast.

In order to absorb the floods from a drainage area of 380 square miles, and render relief to several thousand

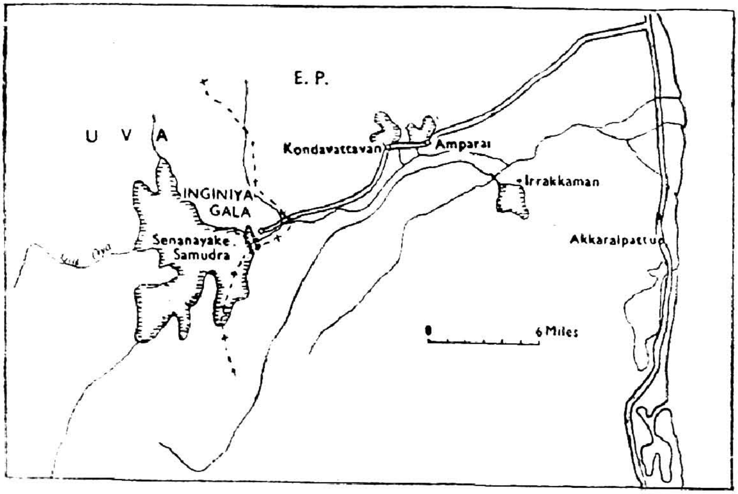
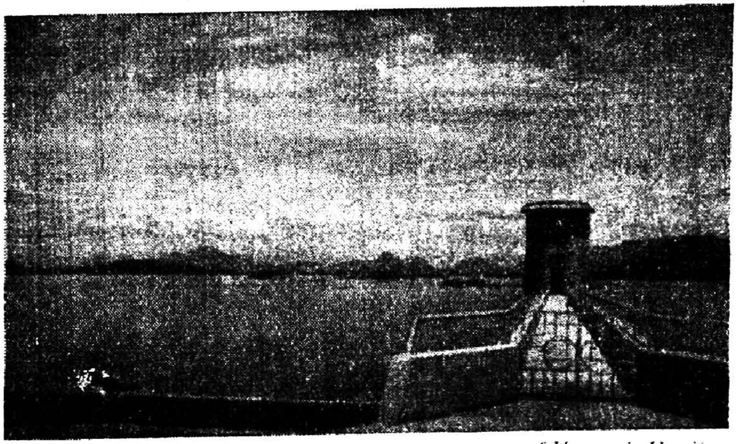


FIG. 49.—The Gal Oya and Pattipolai Aru schemes.

acres of paddy land in the Kalmunai district, a 140-foot high dam was constructed higher up the river just outside the border of the Eastern Province at Inginiyagala—a multi-purpose project to supply water, prevent floods and generate 7,500 kilowatts of electricity by impounding the entire upper basin in a reservoir 36 square miles in area. The old tanks irrigated 27,000 acres for one season. The new reservoir, now named, the Senanayake Samudra will increase this acreage to 60,000, and will hold back sufficient water to irrigate the land for two seasons, thus making the paddy

acreage 120,000 acres for the year. This development will take place in stages. In 1951-2, 6,000 additional acres of paddy land were provided with water from the Senanayake Samudra, and 1,500 colonists, chosen from among landless peasants in congested areas of the wet zone settled here under the authority of the Gal-Oya Development Board. In 1952-3 another 7,000 acres were provided with water and an additional 1,765 families settled. This is one of the largest colonization schemes fostered by the Government, and the



[*Hamavi Hanifa*

FIG. 50.—Ceylon's largest lake—The Senanayake Samudra.

Board contemplated the settlement of some 2,500 families annually for ten years on land ready for cultivation. Each family was given a cottage and seven acres, four acres being paddy land, and three acres of high land all ready for cultivation. As the progress made by the colonists so far has shown that the size of the allotment is too large for the colonist to make optimum use of the land, it has been decided to reduce the size of subsequent allotments to three acres of paddy land and one-third to half an acre of high land.

All the schemes in the Eastern Province depend on a

short rainy season of four months, during which the rainfall is so heavy, that unless the rivers were regulated by tanks, they would be more a source of distress than of profit.

The Kantalai tank derives its water from two streams, the Kumbukmula Oya from the north-west, and the Kitulmuttu Oya from the south-west. Kantalai is one of the most beautiful expanses of inland water in Ceylon, with a straight embankment over one mile in length, over which runs the Dambulla-Trincomalee road. Though about 5,000 acres are irrigated from this tank at present, the tank seldom reaches spill-level, and it is proposed to increase its water supply by restoring the ancient irrigation channel, which formerly connected Minneriya tank with Kantalai.

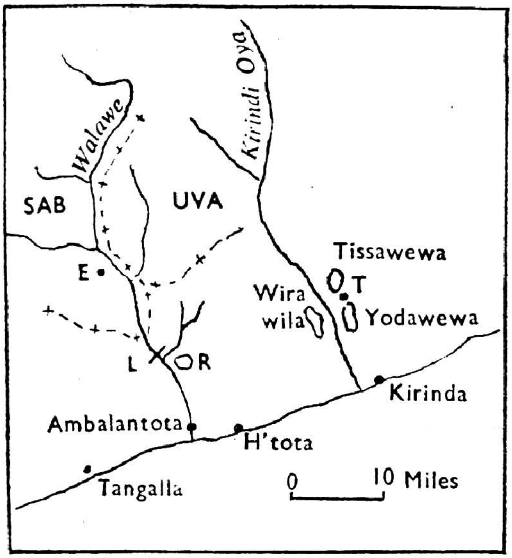


FIG. 51.—The Walawe and Kirindi schemes.
E = Embilipitiya, L = Liyangahatota anicut, R = Ridiyagama, T = Tissamaharama.

The Walawe Ganga is like the Gal Oya subject to heavy floods. The existing scheme is in two parts, the right bank and left bank schemes. The left bank scheme is based on the Ridiyagama tank and irrigates about 8,000 acres, while the right bank scheme, which irrigates 7,000 acres, is based on the Mamadola and Oluwila tanks. The channels for both schemes take off from the Liyangahatota anicut. In spite of these two schemes, the flood water of the Walawe

Ganga runs largely to waste. To utilize this water, it is proposed to construct a 100-foot high dam higher up the river, about three miles to the east of Embilipitiya. The dam will be two miles long, and will impound a reservoir eleven square miles in surface area, and will bring an additional 35,000 acres under cultivation for two seasons, in addition to developing 4,800 kilowatts of hydro-electric power.

The Kirindi Oya scheme is also in two parts, the left bank scheme based on the Tissawewa and Yodawewa, and the right bank scheme based on the Yodakandiyawewa and the Wirawilawewa.

Schemes based on the Mahaweli Ganga.—Several important schemes are based on the Mahaweli Ganga, which rises in the wet zone in the south-west of the Central Plateau, but flows through the north-eastern plain, which has its rain at the opposite season. As it has a great number of tributaries, it draws its water supply from different regions at different times of the year.

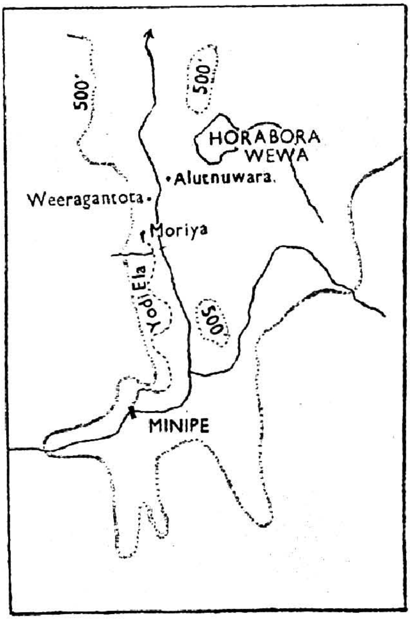
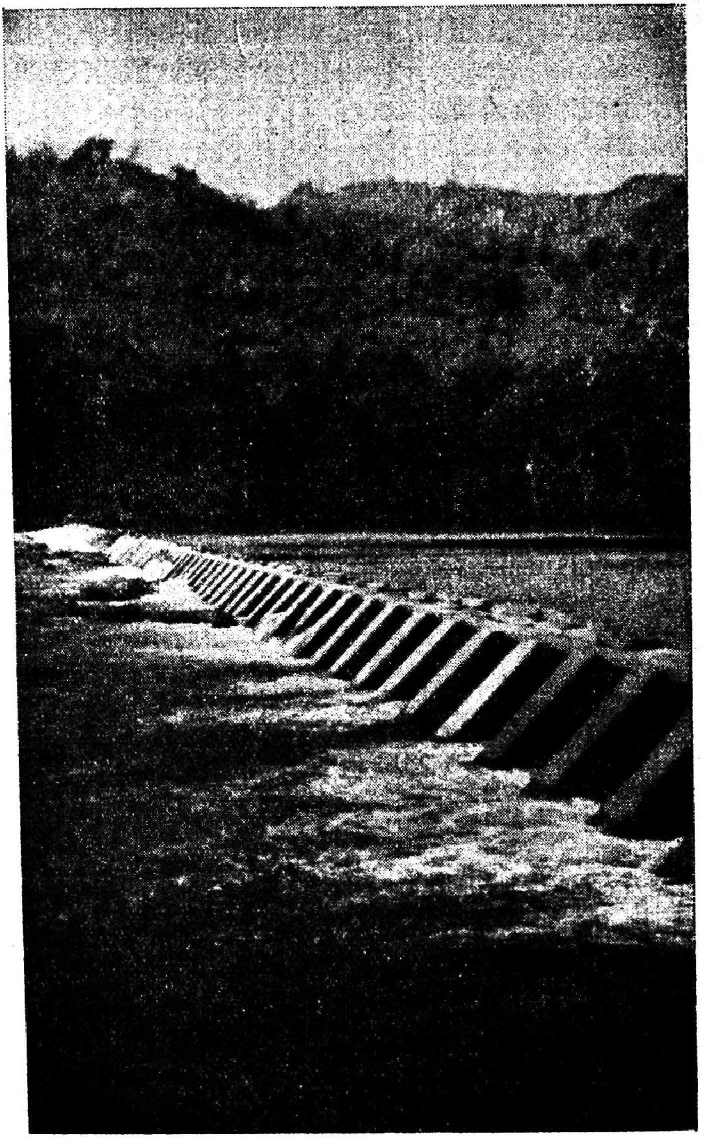


Fig. 52.—The Minipe Scheme.

The Minipe Scheme.—An anicut has been constructed across the Mahaweli at the point where it leaves the hill country and four miles above its right angle bend to the north. From above the anicut an irrigation channel, the Minipe Yodi-ela, conducts water parallel to the main river and about a mile to the west of it. The channel has been

restored as far as Moriya, just south of Weeragantota—a



[A. P. de Mel.

FIG. 53.—The anicut at Minipe.

distance of about 15 miles—and has converted jungle land

to farms given out to colonists. These farms are complete with all facilities including a brick house, so that the peasant can from the start raise sufficient quantities of subsistence crops to maintain himself and his family in reasonable comfort. Garden land and forest land are also assigned to each farm. The average allotment is three acres of paddy and two of high land.

The Elahera scheme is similar to the Minipe, the Elahera Yodi-ela running parallel to the Amban Ganga from the Elahera anicut. It also has for its objective the augmentation of the water supply of Minneriya tank. Twelve miles of channel have already been completed.

Minneriya tank is formed by a dam across the Kiri Oya, a tributary of the Mahaweli. Over 750 colonists have been settled here in model cottages.

The Parakrama Samudra Scheme.—The Elahera anicut must have diverted so much of the water of the Amban Ganga as to leave little for the Sea of Parakrama. The latter was probably fed by a continuation of the Minipe Ela, which ran closer and closer to the Amban Ganga, till it finally entered it at Angamedilla, where there was a second anicut. At present the Sea of Parakrama receives its water supply only from the Amban Ganga. The scheme involves the construction of an anicut 90 feet long across the Amban Ganga at Angamedilla, an inlet channel 3½ miles long, and the joining together of the Topawewa, Dumbutulawewa and the valley of the Eramudu Oya to form a single reservoir, 10 square miles in extent, to irrigate about 18,000 acres. The scheme is nearing completion, about 15,000 acres being already provided with water in 1952.

The Aruvi Aru, Kala Oya and other schemes.—Giant's Tank. This tank is supplied by channel from the Aruvi Aru. The original surface area of the tank was 6,000 acres, but it has been restored to cover only 4,400 acres. It has a bund 5¼ miles long, which runs along the Mannar road

from Murunkan, and then curves round to the east. Designs are in hand to extend the irrigated area by impounding the entire flow of the Aruvi Aru. This will render cultivable 35,000 acres for two crops a year.

The Kala Oya is fed by a number of headstreams of the Kala Oya, which take their rise in the northern parts of the Central Province. The Kagama colony is supplied with water from this tank. The Kalawewa water supply is however quite inadequate in times of drought. It has been therefore proposed to bring additional water to it from the Amban Ganga catchment area by a graded channel through the saddle separating the two catchments. A 120-foot high concrete dam is being constructed at Nalanda for this purpose. The diversion channel runs through the Ebbawala cut following the trace of an ancient cut which diverted water from the Nalanda Oya to Kalawewa through the Welimitiya Oya.

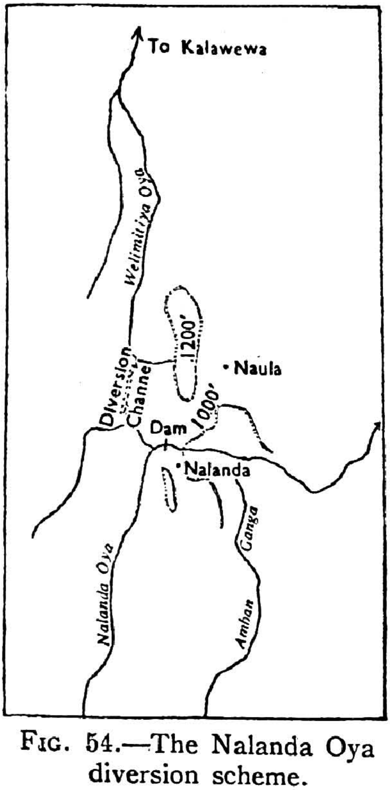


FIG. 54.—The Nalanda Oya diversion scheme.

The Nachchaduwa scheme is based on a number of tanks of which the chief are the Nachchaduwawewa and the Nuwarawewa. The Nachchaduwa tank derives its water supply from the upper Malwatu Oya, which rises in the Ritigala hills in the North-Central Province. Surplus water from the Nachchaduwa tank goes to supply the Nuwarawewa.

Batalagodawewa receives its water from the headstreams

of the Deduru Oya, which as it rises further south in a region of more dependable rains is capable of being utilised to a greater extent. The Ridi Bendi Ela Scheme is intended to serve this end. It diverts water from the Deduru Oya at Ebbawalapitiya into the Magallewewa just south of Nikaweratiya on the Kurunegala-Puttalam road. Already 7,000 acres are irrigated here.

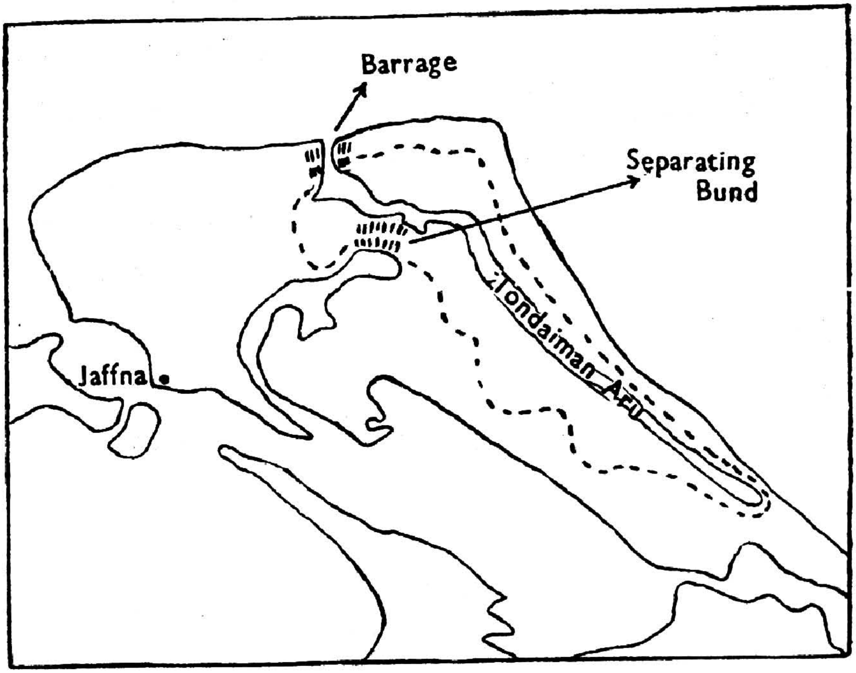


FIG. 55.—The Vadamaradchi Lagoon Scheme.

In Jaffna, on account of the limestone character of the country, there are no surface streams and therefore no tanks. All irrigation in the past was done from shallow wells with an average depth of water of four to five feet. Irrigation is necessary throughout the year, except from October to December. The average quantity of water in a well is about 4,500 gallons, and a well is emptied in about three hours. It recuperates, however, after a rest of about

the same time. Water is drawn from these wells from 4 a.m. to 7 a.m. and from 3 p.m. to 6 p.m. A single well can irrigate about two or three acres. Any attempt to raise water from a well in a shorter time results in brackish water.

The famous well at Puttur is a large rectangular pit, 50′ × 40′, in limestone rock, one side of which is sloped to admit of cattle obtaining access to the water. The water in it is 14 feet below ground level. It has been found that the amount of water that could be pumped with safety is thirty to forty thousand gallons per hour for about ten hours a day. At the end of that time the content of soluble salts rises to about eighty parts in a hundred thousand, which is the limit for garden crops. The area that can be irrigated from this well is therefore about 100 acres.

The Vadamaradchi lagoon scheme, commenced in 1947, is an attempt to convert the Tondaiman Aru salt lagoon into a fresh water lake by constructing a barrage at the mouth of the Tondaiman Aru, to prevent sea water from entering, and a bund to separate it from the Uppu Aru. The barrage is 613 feet long, of which 200 feet are a concrete spillway 2½ feet above sea-level. The other 413 feet consist of 18 sluice gates, which would widen the existing water-way, and let out flood water. The scheme was completed in August 1953. It would take at least another two years before the salt water could be completely turned into fresh. It is hoped to bring 15,000 acres bordering the lagoon under cultivation through this scheme. In the 1953-4 season 1,000 acres were irrigated.

EXERCISES

1. What is irrigation? Why is it necessary in Ceylon? Describe three different methods of irrigation practised in Ceylon.

2. Write geographical accounts of (*a*) the Gal Oya scheme, (*b*) the Minipe and Elahera schemes.

3. 'Irrigation is the key to the development of the Dry Zone.' Discuss this statement.

4. Give some account of the present development of irrigation in Ceylon.

5. Relate the different types of water supply in Ceylon to the geographical conditions.

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CHAPTER 10

AGRICULTURE—FOOD CROPS

Ceylon's economy is predominantly an agricultural one. As such, its industrial activity has been concerned mainly with the processing of its agricultural products. Some minor development of mineral industries such as plumbago, salt, cement, glassware etc. is practicable, but possibilities of heavy industrial development are definitely limited, for the simple reason that power resources are poor. Development of the only power available, viz. hydro-electricity, is barely able to keep pace with the natural increase in demand for domestic use, or for extension to the tea and rubber industries.

Ceylon depends entirely on her export trade in her three main agricultural products, tea, rubber and coconuts. The money obtained by selling these helps to pay for our imports of food and other essential commodities. The first two have perhaps reached their optimum extension of acreage, but there is much scope for the improvement and extension of coconut cultivation, especially as it is a food crop as well. Ceylon is far too dependent on foreign sources for its food supply, and for this reason if for no other, advancement and extension of our food production is a paramount necessity. It offers the greatest possibilities of increasing our total national wealth, by giving us a better balanced economy.

Of a total land surface area of 16 million acres, only about 6¾ million are suitable for agriculture. Of this nearly 3½ million acres are already under cultivation, so that only another 3¼ million acres are available for future development. But it must be remembered that the potential

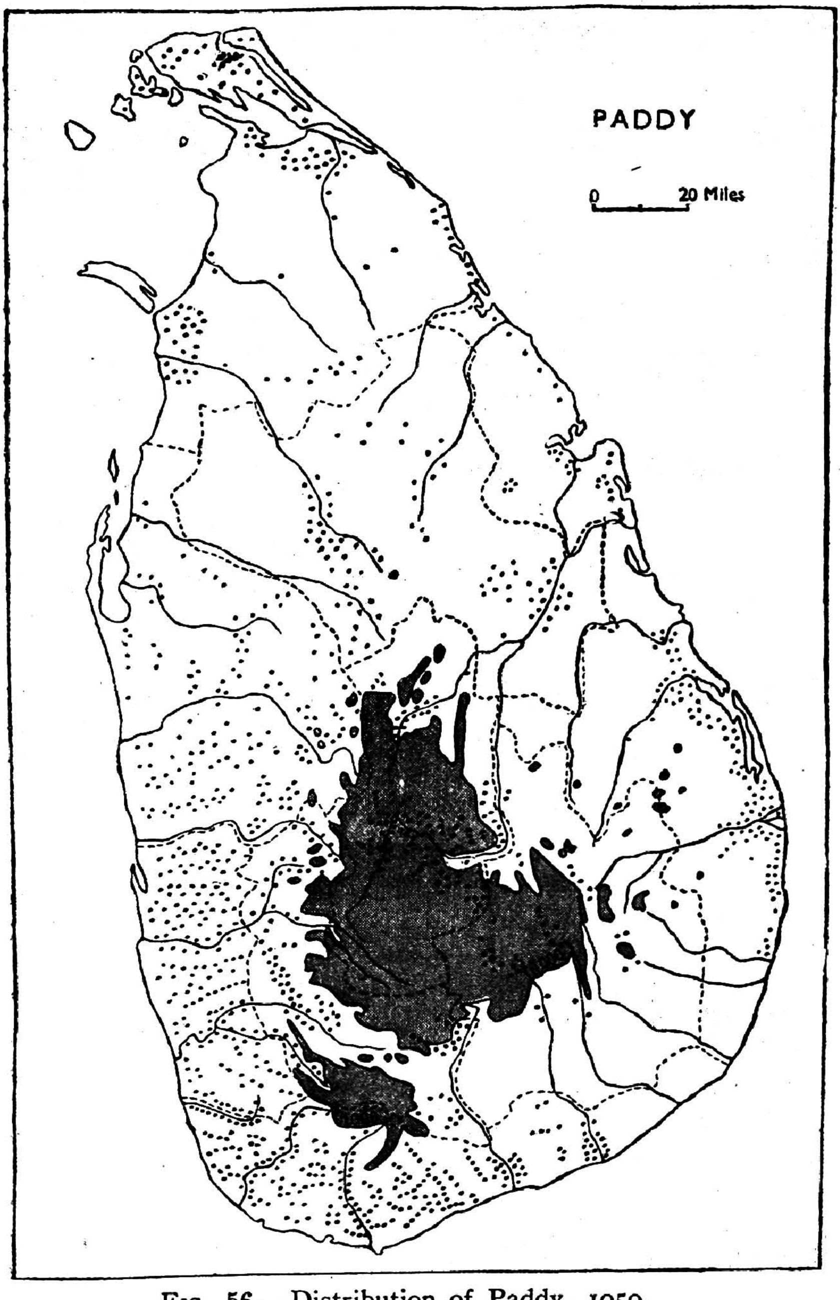


FIG. 56.—Distribution of Paddy, 1950.
1 dot = 1,000 acres. Land over 1,000 feet shaded.

output of the latter cannot be much more than half that of the lands already under cultivation. The wet zone has already been fully developed agriculturally. Though it has a fair acreage under paddy, its climate is not so suitable for this crop, because of its liability to unseasonable rains, and the lack of a sufficiently long dry season to ensure proper ripening. The dry zone, on the other hand, is ideal for rice cultivation, provided a reliable and unfailing supply of water can be ensured by irrigation. In the past its unhealthiness was its great drawback, but with the success attendant on malaria control by the successful application of DDT as a residual spray since 1945, the dry zone alone offers an avenue to an increase of national productivity. Apart from relieving the pressure of population in congested parts of the wet zone, it will help to increase food production, diversify our economy and decrease our dependence on foreign supplies.

The crops of Ceylon fall into two classes: (1) Food or subsistence crops, which are raised mainly for home consumption, and (2) Cash or commercial crops, which are raised primarily for export.

FOOD CROPS

Rice.—The area under wet paddy since 1950 has been a little over one million acres. The present average yield is estimated at about 24 bushels per acre, though random samplings by FAO experts point to a higher figure of about 30 bushels per acre. According to them the Anuradhapura, Kandy and Matale districts have averages of over 40 bushels per acre.

Paddy is cultivated in almost every province. The conditions necessary for its successful cultivation are:

(1) The land must be covered with water for long periods. Hence it requires flat fields which can be easily flooded, and a clayey soil to retain the water. The levelling

and ridging of the land for paddy is known as 'asweddumization'. Where the land is hilly it has to be carefully terraced.

(2) The rainfall must be fairly heavy—a minimum of 50″, or irrigation is necessary. There must be comparatively dry weather when the grain is ripening, as heavy rain at this period will ruin the crop.

(3) The temperature must be high, about 80°F. if the grain is to ripen. Hence it is not grown at elevations much above 4,000 feet. The prevalence of this temperature throughout the year in the lowlands makes it possible to raise at least two crops a year in those parts of the dry zone, where the water supply can be ensured. In the wet zone, however, the hazards of paddy cultivation are (1) failure of rains after the paddy is sown, (2) unseasonable rains at the time of harvesting.

The necessity for keeping the fields under water for long periods makes the valley floors and alluvial flood plains of rivers ideal rice lands. Alluvial soil with a high clay and silt content overlying an impervious layer of clay about two feet below the surface is best. The use of such soil also lessened the need for artificial fertilizers. Where a plentiful supply of water is not available, as in hilly districts of unreliable rainfall, or in chenas (i.e. jungle land cleared by burning for shifting cultivation), hill-paddy (*Elvi*, S.) may be grown.

The chief areas under paddy cultivation are shown in Fig. 56. The largest acreages are in the Southern, Western, Eastern and North-Western Provinces. The following table gives the acreage in each province in 1950.

S.P.	228,000	C.P.	113,000
W.P.	163,000	N.P.	98,000
N.W.P.	141,000	Sab.	93,000
E.P.	122,000	N.C.P.	74,000
	Uva	35,000	

The numerous varieties of paddy fall into three groups, according to the time necessary for their maturing. To the first group belong such varieties as Mavi, Hatiel, Suduwi, and Podiwi, which take six months to mature. The second group takes three months or less to mature, and includes such varieties as Danahal, Murungan, Balavi and Pachahai-perumal, while an intermediate group, which includes Sulai and Vellai illankalayan, matures in about four months.

Much of the paddy grown in the Western and Sabaragamuwa Provinces, and in adjoining districts like Kandy and Galle, as well as in some parts of the dry zone like Jaffna, is rain-fed. In such cases the success of the crop is entirely dependent upon a sufficient rainfall at the proper season. Should the rains fail after the paddy has been sown, the crop will perish. The cultivator then resows with an early maturing variety of paddy, which can mature in the remainder of the season. Early maturing varieties also have to be sown, if the rains are unduly late.

There are two main paddy-growing seasons, both of which are made use of on the same land, when sufficient labour and water are available. The *Maha* crop (Tamil *Kalapokam* or *Munmari*) is sown in September and October and reaped in February and March. The *Yala* crop (Tamil *Sirupokam* or *Pinmari*) is sown in March or April and reaped in August. In both cases a rainy season during early growth, October-November and May-June, and a dry season for proper ripening are thus ensured. In some districts a *Meda* (or *Iddi*) crop is raised between the Maha and Yala seasons.

Ploughing used to be done in the past by small wooden ploughs drawn by buffaloes and cattle. This ploughing merely stirred the soil superficially without overturning it. During the first ploughing weeds are partially buried. A second ploughing is done some ten to twenty days later. Between the first and second ploughings, green manuring is

carried on. Leaves and twigs are buried at the second ploughing, and in some districts leguminous crops, which restore nitrogen to the soil, are specially grown for ploughing in. After the lapse of another ten days a third ploughing may be done, but this is not the rule except in the Central Province.

Artificial fertilisers have not been much used in the past, but attempts are being made to demonstrate to the villager the advantages of manuring. Nitrogen and phosphorus are the principal requirements to be obtained from chemical fertilisers, and suitable mixtures of both, e.g. ammonium phosphate, should be applied at rates varying from half to two cwt. per acre, according to the fertility of the soil, and depending also on whether organic manures are used.

Sowing.—The seeds are generally soaked in water, heaped and weighted down, and allowed to sprout. They are then separated and sown broadcast. In this way seedlings may fall rather unevenly, but this is rectified only after about four weeks, when weeding, thinning out and supplying vacancies are carried out. A better method, which was formerly the practice only in the Central Province and the Kegalla district of Sabaragamuwa, is to sow the seedlings in nurseries until they are four to six weeks old, and then transplant them at regular intervals in the field. Although this method is more costly, the extra expense is more than compensated by the increased yields obtained. But the conservatism and poverty of the villager is such that he requires much more than persuasion to try more costly methods. When transplanted, the plants grow freely and develop more tillers (i.e. productive stalks), while weeds have less chance of developing. Another effect of transplanting is to reduce the seed rate to even half a bushel per acre. The amount of seed sown on an acre used to be two bushels in the dry zone, and four bushels in the wet, while in some parts of Sabaragamuwa and the Central Province,

as much as six bushels had to be used to sow an acre. By such a saving on the seed rate a much greater proportion of the crop will be available for consumption. Transplanting cannot, however, be carrried out unless the water supply is reliable, and the fields can be drained easily.

As the ripening period approaches the plants take on a yellowish hue. The cultivator then drains the water from the field, and allows the paddy to ripen. Reaping is done with sickles, and the sheaves left in shocks or stacks in the field to dry. After some days they are carried to the threshing floor, where the dried sheaves are spread out, and buffaloes or cattle yoked together and made to trample on them, till all the grain has been separated from the stalks. The straw is then raked off and the paddy collected and winnowed to separate the fine grains from the empty husks.

In its attempt to increase food production, the Government has begun an Island-wide drive to improve paddy yields. A number of demonstration plots have been set up all over the Island in the midst of the villagers' own lands, where the peasants could watch the crops' progress, and determine from their own observations the value and feasibility of the improved methods of cultivation shown to them. The demonstrations are intended to show the value of (*a*) iron ploughs and other more efficient implements, (*b*) transplanting, (*c*) manuring and (*d*) the use of selected seed.

Through Co-operative Agricultural Production and Sales societies financial help is given to cultivators to enable them to purchase better seed and other planting material, manure, implements and cattle, and also for adopting improved agricultural practices, such as transplanting, harrowing the standing crop and threshing. As a result, light iron ploughs are progressively replacing the village wooden plough. In the Western Province alone there are over 10,000 light iron ploughs in use. The other implement recommended is the toothed harrow, introduced originally

from Burma, for use in puddling the soil after ploughing, and also for levelling. It is also useful for harrowing the standing crop when three to four weeks old as a measure of weed control. The value of pure-line paddies is being increasingly appreciated, and the demand for seed far exceeds the supply. A large number of private seed farms have been organised to increase the supply from the Government seed stations. A start has also been made with the hybridizing of paddies. And above all, the Government has introduced a Guaranteed Price Scheme, which ensures for the cultivator, not only a ready market, but also an attractive price.

According to the official returns total production amounted to 19,000,000 bushels of paddy in 1951-2. This, when reduced to terms of rice, barely amounts to 10,000,000 bushels. Our annual imports of rice, on the other hand, average 20,000,000 bushels. Thus two-thirds of our rice requirements are at present imported, and production amounts to only one-third of the total amount consumed. The actual position is somewhat better than that disclosed by the official figures. The reliability of these in the last resort depends on the conscientiousness and efficiency of the village officials—not to mention the natural reluctance of the peasant to disclose the full extent of his crop, and surrender the surplus to Government at what he considers too low a price. The system of tenure, too, causes most of the surplus to go to the landlord. In realisation of all this, the Government has gradually raised the guaranteed price to the peasant to Rs. 12 a bushel, and undertaken to guarantee prices for a period of three years.[1]

Other Food Crops.—These are mainly cultivated in the dry zone. They include various millets of which the chief

[1] By 1954, production had increased to reach half the total amount consumed. A recent development is the attempt to introduce Japanese methods of cultivation, the essentials of which are: (1) stringent weed control, (2) heavy and judicious manuring.

are Finger Millet or Kurakkan, (*Eleusine coracana*), Italian Millet or Tanahal, Paspalum Millet or Amu, Panicum Millet or Meneri, and Sorghum. Other dry zone crops are maize, chilly, gingelly, onions, horse-gram (Kollu), green-gram (Mun-Eta) and mustard.

Kurakkan occupies over 80,000 acres. The plant has erect ear heads, each of which is a cluster of about five finger-like spikes. Hence the name 'finger millet'. The seed is small, round and dark red in colour. Kurakkan thrives best in the dry zone. It is usually grown as a chena crop in the first and second years after clearing the jungle. It is able to withstand periodic drought, but the yield under such conditions is low, being barely ten bushels per acre. But with a rainfall of 35 to 40 inches, well distributed during the growing season, much higher yields are possible; and with better methods of soil preparation, sowing and rotation of crops, yields of twenty bushels per acre are obtained. As in the case of paddy, transplanting results in the highest yields, and should be adopted wherever possible. As an irrigated and transplanted crop in the Jaffna Peninsula, where it is grown in rotation, yields of nearly 40 bushels per acre are obtained. Where irrigation is not possible, sowing is done only for the Maha season, i.e. in October and November and reaped in February and March. In Jaffna it is planted in different months between February and September, according to the particular crop rotatoin practised. Kurakkan will also grow in those parts of the wet zone where the rainfall is not too high, up to an elevation of about 4,000 feet. The annual production in recent years has been about 700,000 bushels.

Maize ranks as Ceylon's third cereal, from the point of view of both acreage and production. It occupies an extent of about 37,000 acres, and is generally grown as a mixed crop in chenas and in village gardens, where the soil is rich. The plant is a tall grass over six feet in height, and

has long and broad leaves. The ear-heads, or cobs, are produced, not at the top of the stalk, but some way down in the axils of the leaves. About two or three cobs are developed on each stem. The plant serves both as a grain and a fodder crop.

Maize grows best in the drier regions of the hill-country, but it can be successfully cultivated anywhere, up to about 6,000 feet, provided there is a dry season when the cobs are maturing. Such conditions obtain both in the wet and dry zones, mainly during the Maha season, as there is a sufficient rainfall during the growing period, and dry weather during the flowering and ripening period.

Maize can be eaten tender as 'corn in the cob'. When mature and dry, it is coarsely pounded and boiled to a gruel and eaten as hominy or ground to a flour. The flour does not make good bread, but it is now used in Ceylon to adulterate wheat flour. As a staple food it is not to be recommended, as maize-eating populations are liable to a disease known as pellagra. The annual production of maize in Ceylon is about 300,000 bushels.

In marginal regions it is an uncertain crop. It is not capable of withstanding long periods of drought, nor of making use of the smaller amounts of effective rainfall that break the longer droughts. It is not a good crop for conserving either water or soil. It should not be grown on slopes, for its cultivation tends to encourage run-off and erosion. It also makes a heavy demand on soil nutrients, and should never be grown except in rotation with leguminous crops.

Sorghum.—Sorghum or Great Millet has the largest grain of all the millets, and is a crop to which more attention should be paid. Since 1949 the Department of Agriculture has been trying to popularize its cultivation. Its capacity for withstanding periodical drought, its ability to grow even on poor soils and its tendency to produce some yield

even in most unfavourable seasons, make it a far more dependable crop than maize.

Manioc.—Manioc appears to occupy a rather large acreage (about 150,000 acres) mainly in the wet zone. It is an exhausting crop, and unless the soil is fairly rich in humus, requires liberal applications of manure. It should always be grown in rotation, so that it may not impoverish the soil. In virgin soil where there has been no previous cultivation, manioc can be profitably grown without manure. The plant resists drought well, once its root system has developed. Apart from its use as food, it is an important source of starch (tapioca) for commercial purposes, and can also be used in the manufacture of sago.

Gingelly or *tala* (28,000 acres) is produced mainly in the North-Central Province and in the Jaffna, Kurunegala and Hambantota Districts, where it is the main *Yala* crop in the chenas. It is very suitable for production in the colonization schemes. It is capable of good growth under moderate rainfall, but does best when the distribution is fairly even. It thrives on light, well drained soils. Apart from its use in the preparation of sweetmeats and in cooking, it is of commercial value and can become a valuable export.

Onions.—About 10,000 acres have been cultivated with onions in various parts of the dry zone and the Central Province, but mainly in the Jaffna Peninsula. The Department of Food Production is attempting to increase the acreage under onions, with a view to reducing imports as much as possible.

Chillies (28,000 acres) thrive in the dry zone, and may be grown up to an elevation of about 3,000 feet. The crop is suitable for production in the colonization schemes, where it could very profitably be grown in rotation with other crops. This is another crop of which increase in local production would help to cut down imports.

Tomatoes grow best in the dry zone, and while requiring a light rainfall during the growing period of about two months, must have dry weather with occasional showers for fruiting and ripening. These conditions may be obtained by sowing in October and November in those parts of the dry zone, where the annual rainfall is not much above 60″. Tomatoes thrive well on rich, sandy loams, which are deep, well drained and open. Such soils are sufficiently retentive of moisture to make continual irrigation during dry weather unnecessary. The chief area of tomato growing is the Hambantota District around Ambalantota, Tissa, Ranna and Wiraketiya. Another region of importance is the dry zone hill country, where in Pata Hewaheta tomatoes are grown on paddy lands during *Yala,* at which season the water supply often proves insufficient for paddy cultivation.

Plantains (bananas) are widely grown, but are of particular importance between Polgahawela and Rambukkana.

Sweet potatoes occupy an acreage of about 36,000 mainly in the wet zone. The crop prefers a light loam, well drained but with plenty of moisture, and a moderate fertility. The Southern Province has the largest acreage.

Potatoes are grown in the vicinity of Nuwara Eliya, and in parts of Uda Pussellawa and Upper Uva. Though the total acreage is infinitesimal, it has been estimated that with an average annual production of four tons per acre, it would be possible, with an acreage of 5,000, to make imports of potatoes unnecessary. The Department of Agriculture is attempting to encourage production by conducting trials and demonstrations, both in the hill country and in Jaffna.

Other crops of the temperate zone, such as English vegetables, cabbages, carrots, etc. are cultivated in small plots in the higher parts of the hill country, e.g. at Kandapola.

Sugar-cane cultivation has long been carried on in the Gin Ganga valley around Baddegama and Nagoda, but as sugar requires a dry season before harvesting, experimental farms have been set up by the Government in various parts of the dry zone, particularly at Polonnaruwa and Maha Illuppallama in the North-Central Province, and elsewhere. These experiments have shown that for the first few years the productivity of the soil is high, but it diminishes rapidly thereafter, unless steps are taken to conserve or replenish the organic matter in the soil. In this respect, the residues of root and stubble are important in reducing the depletion of soil to a minimum, as sugar, being pure water and carbon dioxide, does not make much mineral demand on the soil. Nevertheless, the elaboration of sugar by the sugar-cane plant calls for the presence, among other things, of minerals. The efficiency of sugar elaboration is proportionate to the amount of minerals. It has been found in Java that paddy cultivation and sugar-cane go well together, offering distinct benefit to both crops. Apart from soil amelioration, the labour distribution is also benefited. Sugar-cane requires much labour during the dry season, and practically none during the wet period. Paddy, on the other hand, has a labour peak during the wet season. Thus a combination of both crops grown in rotation on adjacent lands would provide satisfactory employment all the year round. Cane tops can also be used as fodder, and this will be available during the dry season, when other fodder in the dry zone is scarce. Bagasse, or refuse from the crushed cane, provides a good fuel for the sugar mills, and the furnace ash from bagasse makes a good fertiliser for paddy.

The Government has, however, decided against any rapid extension of cultivation just yet, and has confined itself to stepping up cultivation in the Gin Ganga basin, where cultivators have asked for help. At present, about

500 acres are under cultivation, yielding nearly 5,000 cwt. of cane. There are two power driven mills, and six worked by oxen. Producers have asked for government assistance in opening up two more power driven mills, and an additional 1,500 acres are being brought under cane in this area.

EXERCISES

1. What conditions favour the production of Ceylon's chief food crop? State how far this production meets the needs of the country, and discuss ways and means of increasing the output.

2. What minor food crops have an acreage of over 50,000 in Ceylon? Give a geographical account of the production of each.

3. Arrange in order of decreasing importance those food crops that have an acreage of less than 50,000. Describe the geographical conditions of production of any *two* of these.

4. What geographical conditions affect the growing of (*a*) maize, (*b*) sugar-cane? Describe the efforts made to cultivate them in Ceylon.

CHAPTER 11

AGRICULTURE—MAJOR COMMERCIAL CROPS

Commercial or cash crops are chiefly raised in the wet zone. This is the case not only with the major crops, tea, rubber and coconuts, but also with several minor crops, such as arecanuts, cacao, cinnamon, cardamoms, pepper, papaw and kapok. Only a few belong definitely to the dry zone, e.g. tobacco, cotton.

The major commercial crops are for the most part grown in large estates or plantations. These plantations are characterised by all or some of the following features:

(1) A large acreage per estate.

(2) The employment of a large and skilled labour force, often recruited from a distance. In recent years, with the repatriation of Indians, labour is being increasingly recruited from nearby villages.

(3) Specialization in a single crop. This practice has been somewhat modified in recent years, especially in the case of rubber, which is sometimes inter-planted with cacao, e.g. in the Matale District.

(4) Production primarily for export. In the case of coconut, however, the home market is almost equal to that of the export market, and is likely to absorb even more of the output in the future. Coconut is also predominantly a product of the small-holder.

(5) Production of crops that require planting as opposed to sowing. This means that the crops are tree crops obtained from perennials, and do not have to be sown every year. Thus in the case of most of them there is a considerable time lag between the planting and the collection of the first return.

(6) Financial and executive control by foreigners, as in the case of most of the tea estates. In recent years, however,

many estates have been bought up by Ceylonese, and the proportion of foreign-owned estates is likely to diminish still further. This has not, in several cases, yielded beneficial results. Fragmentation has lowered the efficiency of many estates. In other cases the estates are not getting the care and attention devoted to them by the British planters: profits in the tea trade are so large and certain just now, that many new owners are not putting enough money and effort into the maintenance of the estates. This is a short-sighted policy, which may have serious effects on the Island's economy in the future.

Tea is the most valuable commercial crop grown in Ceylon. Of countries producing for the world market, Ceylon ranks second both in production and acreage. The following table gives the acreages of the leading countries:

India and Pakistan	840,000 acres
Ceylon	574,000 ,,
Java and Sumatra	510,000 ,,
U.S.S.R.	125,000 ,,
Formosa	105,000 ,,
Japan	100,000 ,,
Nyasaland and Kenya	25,000 ,,

The tea shrub is a sub-tropical plant requiring a temperature of about 75°F. during the day, but it is hardy and can withstand occasional frosts. It needs a heavy rainfall of about 80″ or more, but water must not remain at the roots. For this reason it is grown on hillsides, the principal areas under tea being the south-western and central hill country. Tea is grown at various elevations: low-country teas up to about 2,000 feet, medium grown teas at altitudes ranging between 2,000 and 4,000 feet, and high grown teas above 4,000 feet. The latter tend to produce smaller crops, but the best quality, as the cooler climate helps to produce a better flavour. A period of drought too, by restricting the yield of leaf, greatly improves the flavour.

AREA UNDER TEA IN THOUSANDS OF ACRES BY PROVINCES

Central Province	328
Uva	95
Sabaragamuwa	92
Southern	46
Western	12
North-Western	1

The plant in its natural state grows to a height of some twenty to thirty feet, but on the estates its growth is controlled by periodical pruning, so as to ensure regular, frequent and plentiful flushes. It is thus maintained as a bush three or four feet high for convenience in plucking. The flush is the unopened leaf bud and the next two leaves. These are plucked by hand generally by the women of the labour force. An abundance of cheap labour is thus essential for the plucking of the leaves the moment they are ready, as the various flushes yield teas of differing flavour, and a delay in plucking affects the flavour. Most of this labour is supplied by immigrant Tamil labourers from South India. About one labourer is necessary for every acre, with an extra labourer for every eight acres.

The yield of leaf varies considerably according to elevation and methods of cultivation. It ranges from 300 lbs. to as much as 1,200 lbs. of manufactured tea per acre, the average being about 500 lbs. per acre. The plant is only fit for plucking after it reaches maturity, a process which takes from about two years in the low-country to about four in high altitudes. Other trees are planted among the tea to provide shade, to check soil erosion, to act as wind breaks, to supply green manure, and even to provide timber. Acacia, dadap, grevillea, albizzia, gliricidia and eucalyptus are the chief of these. After about two or three years of productive activity, however, the plant loses the vitality necessary to send forth an abundance of new shoots. It then has to be pruned. The

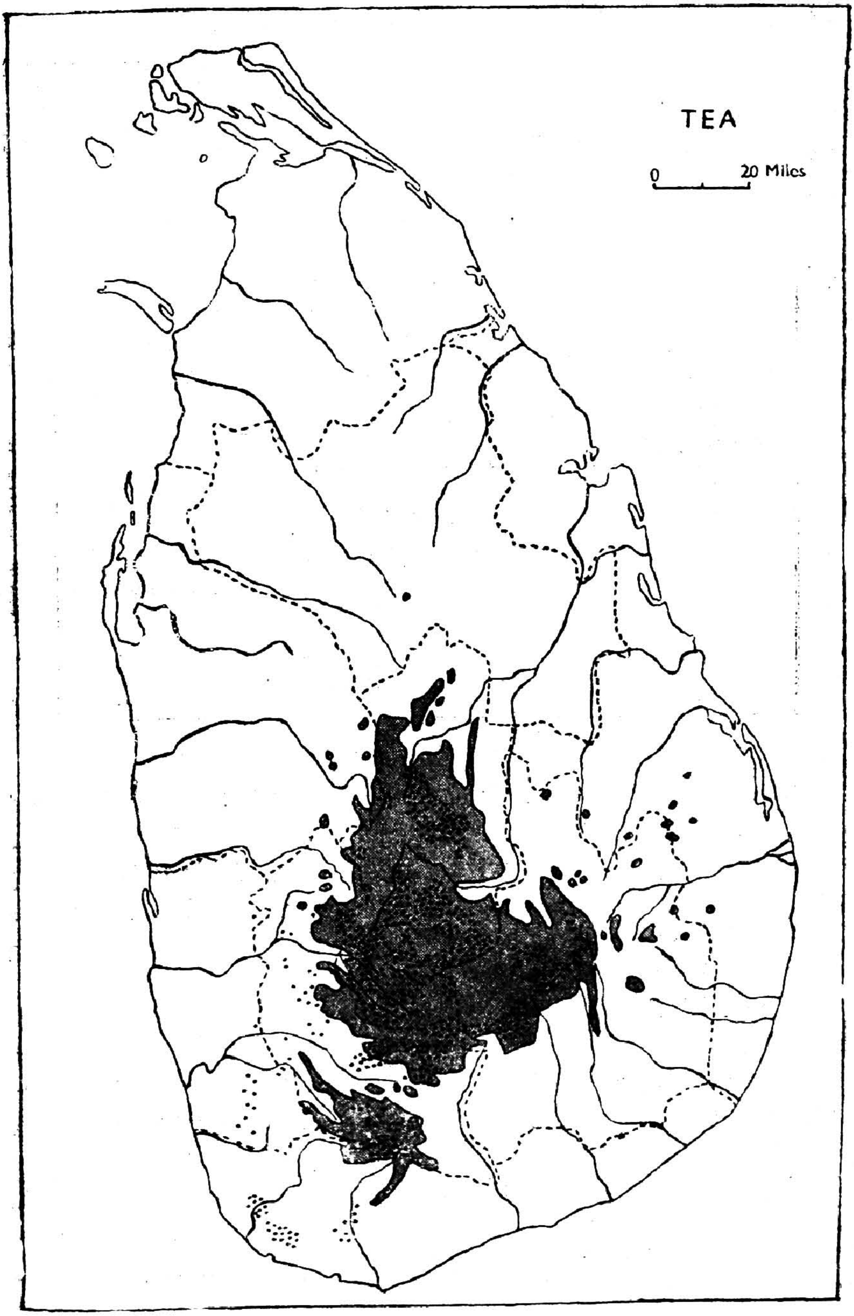


FIG. 57.—Distribution of Tea. 1 dot = 1,000 acres. Land over 1,000 feet shaded.

young flush-producing branches which form the upper part of the bush are lopped off, and the main branches cut back to a suitable level, to allow room for subsequent upward growth.

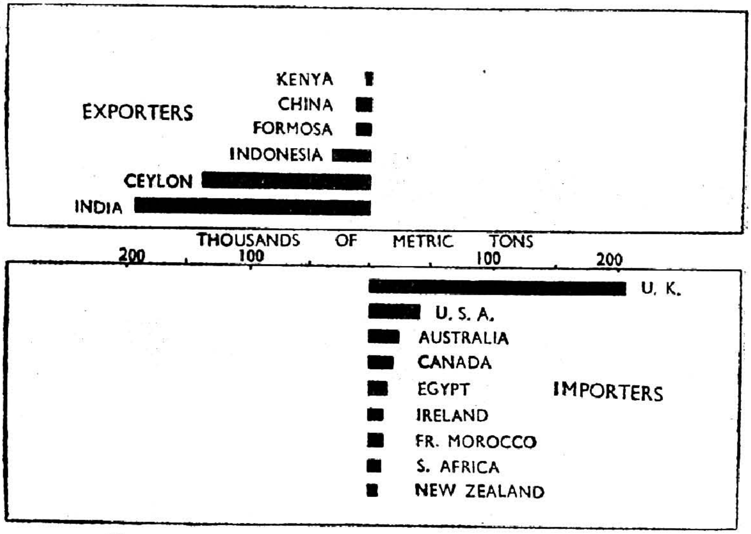


FIG. 58.—World Trade in Tea, 1948-52.

The conversion of the green leaf into the finished product is carried on in the factory, where it undergoes five distinct processes—withering, rolling, fermenting, firing and grading. Green tea is prepared by steaming the green leaf instead of withering, and by omitting the fermenting process. The amount of green tea produced is negligible.

The chief grades are Broken Orange Pekoe, Orange Pekoe, Broken Pekoe, Fannings and Dust.

India is our chief competitor in the tea trade. The other Commonwealth countries are the chief purchasers of Ceylon tea, the United Kingdom alone taking about 35% of our exports. Other buyers are Australia, U.S.A. and Egypt. Our annual exports amount to well over 300,000,000 lbs., while local consumption barely reaches 20,000,000 lbs.

Rubber, though it occupies a larger acreage than tea, is far behind it in value. It is also a product that is subject to many ups and downs in the world's markets, periods of boom and depression succeeding each other in the most disconcerting manner. Generally speaking, over-production has led to a depression in prices, while war and artificial forces, such as the buying of rubber by foreign governments lead to a boom. Ceylon produces only about 5 per cent of the world's rubber, and therefore prices are determined largely by conditions of production outside Ceylon's power of control. Plantation rubber production is a highly capitalized industry because of (1) the interval between planting and obtaining of the first return, which is not less than six years, and (2) the heavy labour costs both for initial jungle clearing and of recurrent maintenance costs during growth.

The following are the acreages under rubber in the leading countries:

RUBBER ACREAGES, '000 ACRES (1951)[1]

	Estates	Small holdings (under 100 ac.)	Total
Indonesia	1,567	3,179	4,746
Malaya	1,975	1,580	3,555
Thailand		700	700
Ceylon	343	312	655
Vietnam & Cambodia	311	22	333
Sarawak	18	222	240
Belgian Congo	145	47	192
India	103	67	170
Brunei & North Borneo	86	69	155
Nigeria	19	101	120
Burma	68	42	110
Liberia	77	18	95

[1] Rubber Statistical Bulletin of the International Rubber Study Group 7, No. 3, 1952. Quoted in 'World Crops,' May 1953.

The rubber tree, *Hevea braziliensis*, which, as the name implies, is a native of Brazil, is a typical equatorial tree, requiring a uniformly high temperature (80°F.), with no great variation. Hence the ideal elevation at which it would thrive is from sea-level up to about 1,200 feet. Though there are a few producing areas at elevations of about 2,000 feet, they have not been found conducive to high yields. It needs a well distributed rainfall of about 80″ or more per annum, but the soil must be well drained. It is accordingly grown on sloping ground chiefly on the lower hills. In order to prevent soil erosion, cover crops generally of a leguminous kind are grown between the trees, both to protect the soil and provide green manure.

The chief rubber estates are in the wetter south-west, chiefly in the Sabaragamuwa, Western and Central Provinces, though there is a small production in the wetter parts of Uva. Very heavy rain interferes with the collection of latex, and this causes a diminution of the yield in rainy months like May and June, when there is much rain in the south-west. The trees are usually given a rest from tapping for a few weeks in February or March, which is the season of leaf fall.

RUBBER LANDS, '000 ACRES, 1953 BY PROVINCES

Sabaragamuwa	246
Western	186
Southern	100
Central	85
Uva	21
North-Western	19
Ceylon	657

The trees are allowed to grow for at least six years before they are tapped for latex. A tree reaches maturity

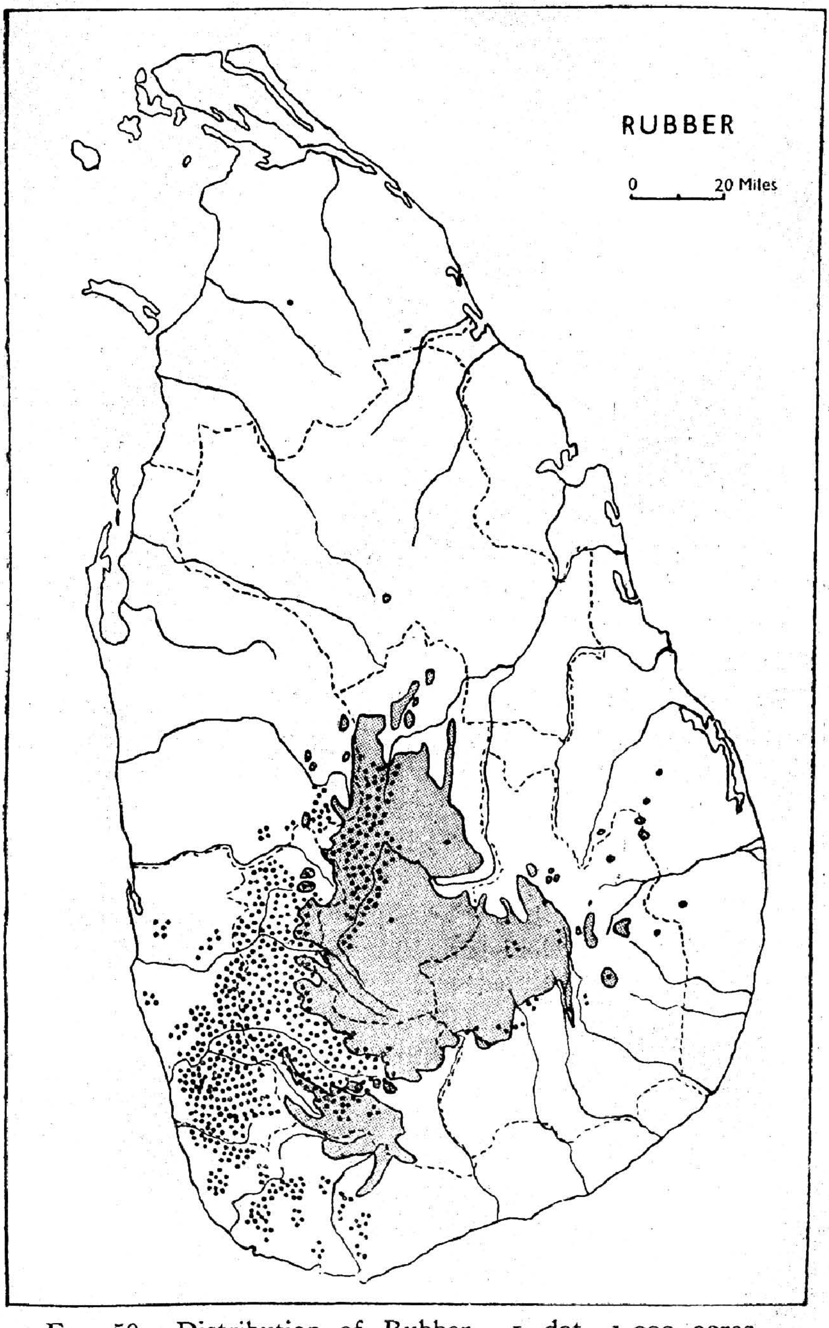


FIG. 59.—Distribution of Rubber. 1 dot = 1,000 acres.
Land over 1,000 feet, shaded.

only after twelve years, and then yields about 4 to 6 lbs. of dried rubber a year.

Most of the rubber grown in Ceylon is seedling rubber from unknown parent trees. Since the discovery that plants produced vegetatively by budding from known high-yielding parent trees give higher yields, all new planting is done with budded rubber, i.e. by grafting of buds from high-yielding parents on to young seedlings. High yields are also obtained by planting specially selected seed known as clonal seed.

The latex is obtained by cutting a ring of bark less than half-way round the lower trunk of the tree. It is made to drain into little containers fixed at the bottom of the cut, collected in buckets, taken to the factory, poured into pans of the required size for sheets and mixed with acetic acid. The acid causes the latex to coagulate—a process which takes about eighteen hours. When coagulation is complete, the sheets are turned out of their moulds and passed through rolling machines, until they acquire the required thickness. They are then put through a machine which impresses on them a pattern to prevent their sticking together when packed. Then they are hung up and smoked to form sheet rubber, or dried to form crepe rubber. The yield ranges from 150 to 700 lbs. per acre, 450 lbs. being considered a good yield for old seedling rubber.

The average yield for the whole of Ceylon was 412 lbs. per acre in 1950, and there has been a steady decline since then to 380 lbs. in 1951 and 350 in 1952, so that a good proportion of Ceylon's rubber lands give an uneconomic return. To remedy this state of affairs the Government in May 1950 introduced a scheme of assistance for the rehabilitation of rubber lands. Under this scheme proprietors of uneconomic rubber lands were given long-term loans for the purpose of replanting their lands with high-yielding rubber, or replacing them with other crops. More positive assistance in

the form of a subsidy for replanting was begun in 1953. The subsidy takes the form of actual monetary grants to a maximum of Rs. 1,000 per acre and the issue of subsidized fertilizers. Under this scheme 8,000 acres were replanted in 1953, and 18,000 acres in 1954, while 27,000 acres will be re-planted in 1955. Also, land over 1,200 feet in elevation will not in future be subsidized for re-planting with rubber, but with cacao.

Though rubber tapping does not require so numerous a labour force as tea plucking, yet skilled labour is essential. Cleanliness in all the operations of tapping is necessary. Before the tapper begins work on a tree, old bark shavings must be scraped off, and dew or rain water that collects in the cup must be removed. Great care must be taken that there is no dirt on the knife with which new parings are removed to liberate the flow of latex. Rubber estates require about one labourer for every three acres. Our tappers, however, do not compare favourably in efficiency with those of Malaya and Indonesia.

The annual production of rubber, though liable to much fluctuation, is about 100,000 tons. Local consumption is very small, being only about 300,000 lbs. Exports go mainly to U.S.A. and England, where the rubber undergoes further processes of manufacture to make tyres and other rubber articles.

The production of plantation rubber must be ranked as one of the most temperamental of all enterprises. Wars and rumours of war lead to furious stock-piling and create boom conditions resulting in expansion and over-production. The fall in price in the ensuing depression is thus all the more catastrophic. The estate, with its army of hired labour and heavy expense of management, is particularly vulnerable in this respect. Countries like Indonesia, where the major proportion of rubber is peasant produced, are not so affected by the vagaries of the rubber market. When prices are high, the peasant rubber growers can produce to

their highest capacity—the labour being provided by the family and a few friends and relatives. When prices fall they can cease production without suffering undue hardship. Hence they have won for themselves an important place in rubber production, and at the present time the acreage under peasant production in Indonesia is double that under plantation rubber.

The loss of Malaya and Indonesia to Japan during the Second World War gave a fillip to the production of synthetic rubber in U.S.A. Though synthetic was hitherto not quite the equal of natural rubber, it has been recently reported that American chemists have succeeded in reproducing the true molecule of natural rubber. Under these circumstances, it will not in future be possible for natural rubber to command too high a price. There is no doubt that if the natural rubber industry is to survive the competition of synthetic, and earn a reasonable rate of profit, it must seek to lower costs of production. This can best be done by replacing old trees with superior yielding clones. In Ceylon, rubber has therefore to face two rivals: synthetic rubber, and the more efficiently and cheaply produced Malayan and Indonesian small-holders' rubber. The need for re-planting with high-yielding clones is therefore more imperative than elsewhere.

In recent years over 2,000,000 metric tons of rubber have annually entered channels of international trade. Of this amount Ceylon has contributed only one-twentieth, taking third place as an exporter after Malaya and Indonesia. In the pre-war period U.S.A. and U.K. were the chief purchasers of Ceylon's rubber; but since 1952, as a result of the China-Ceylon Trade Pact, China has been the chief purchaser, taking as much as 32% of our exports. U.S.A. purchases have declined from 52% in 1950 to 19% in 1952. The United Kingdom takes about 17%.

Coconuts occupy the largest acreage (920,000 acres) under any single crop. This figure refers to holdings of over

one acre in extent. If to these are added the smaller plots of less than one acre, found in town and village gardens, which amount to 155,000 acres, the total acreage amounts to well over a million acres. This is the one form of plantation agriculture that is almost entirely under Ceylonese ownership and management, and as it is one that involves the least labour and supervision, it is the most popular form of industry with the Ceylonese capitalist. There is probably less work to be done in the running of a coconut estate than in any other comparable enterprise in the world.

The coconut palm requires a high mean annual temperature of 75°-80°F. or over, and a rainfall of 60-90 inches well distributed throughout the year. When grown outside the 60-inch isohyet, the tree does poorly, and even within it, occasional droughts cause a drop in the yield. The palm grows best on a sandy soil, generally along the sea coast, but is grown successfully even in the interior, as far inland as Kurunegala. The temperature requirements exclude it from most of the hill-country, except from those parts below an elevation of 1,700 feet, but even so, altitude influences unfavourably both the yield and size of the nuts.

On an average about sixty palms are planted to the acre. A palm yields about 50 nuts per annum, thus making the average annual estate yield 3,000 nuts per acre. With proper cultivation and attention trees come into full bearing in about six years.

From the point of view of labour requirements coconut is the least exacting of all the plantation crops, plucking being done only once in two months. On an average, one labourer will suffice for every ten acres.

The chief coconut lands occupy a belt along the south-west coast between Tangalla and Puttalam, rather narrow where the hill-country reaches closer to the sea, e.g. behind Galle and Ambalangoda; but farther north in the hinterland of Negombo and Chilaw, it extends more deeply

inland to Polgahawela and Kurunegala. There is some production along the Batticaloa coast, but in Mannar and Jaffna the trees do poorly on account of drought. The following are the acreages in the provinces:

N.W.P.	420,000	C.P.	32,000
W.P.	233,000	N.P.	24,000
S.P.	103,000	E.P.	21,000
Sab.	82,000	N.C.P.	2,750
	Uva	1,500	

On the better kept estates ploughing and manuring are systematically done. Husks are buried into the soil, and green manure and chemical fertilisers also used. The trees require protection from their natural enemies, such as rats and coconut beetles. The great majority of coconut lands, however, do not receive all this attention. The proprietors try to get all they can from their estates, and put as little as possible back into the land. Little attention has been given to re-planting, and as most of the trees are over fifty years old, yields are becoming more and more uneconomic. In 1948, the peak year of production, the average yield was only 1,900 nuts per acre. As such a state of affairs is likely to have severe repercussions on the national economy, a scheme for rehabilitating the coconut industry was initiated in 1949 with the aid of special annual grants. Twenty-five nurseries for the production of high grade seedlings have been established, and about 15,000 acres have been re-planted. The rate of re-planting will have to be raised to 15,000 acres per annum, if the decline in production is to be arrested. It is the declared intention of the Government to subsidize the provision of seedlings to maintain this rate of re-planting.

The principal products exported are copra, oil, fresh nuts, desiccated coconut, poonac and coir fibre. Other products, mainly of local importance, are arrack, toddy, jaggery, vinegar and coconut-shell charcoal.

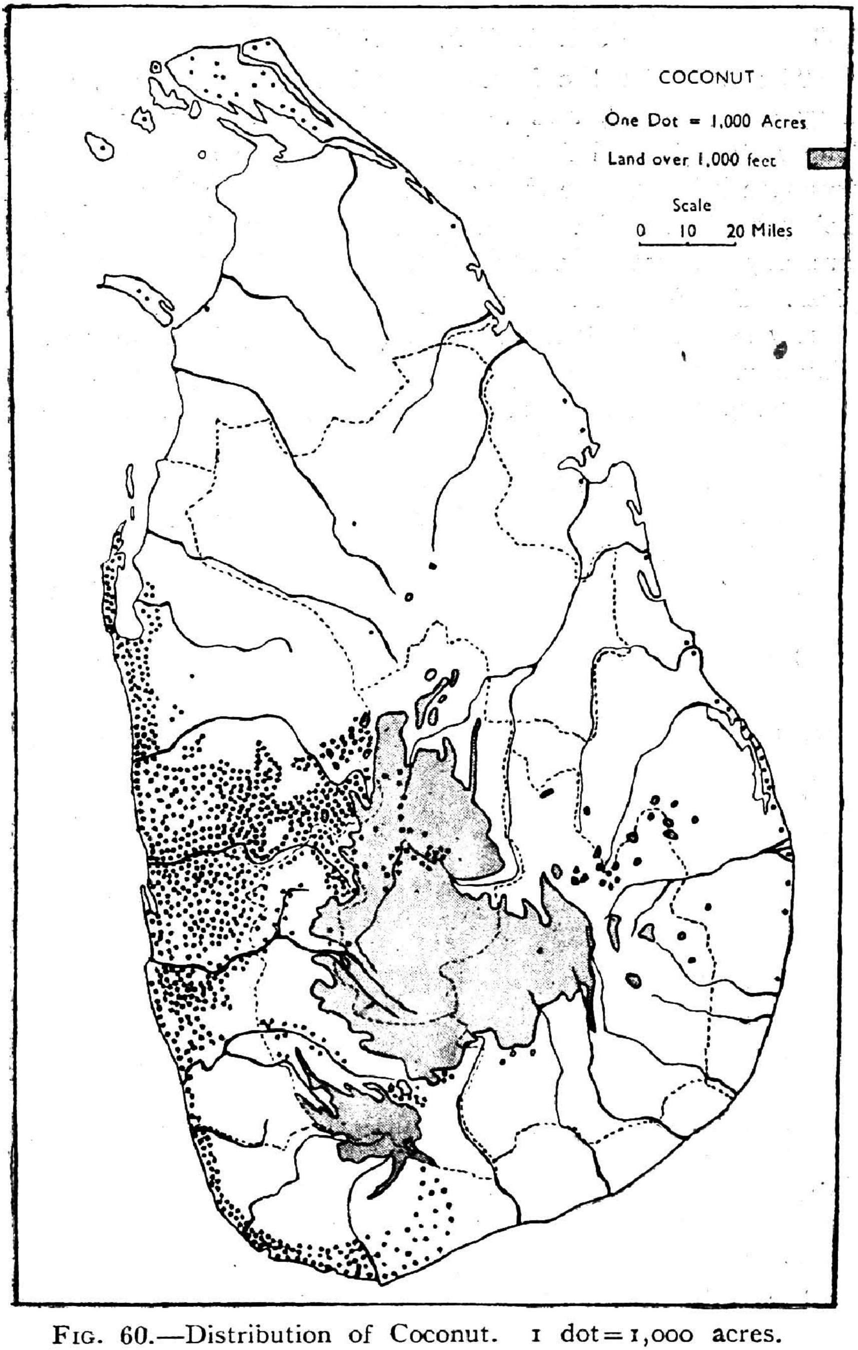


FIG. 60.—Distribution of Coconut. 1 dot = 1,000 acres.

The nuts for the home market are husked soon after they are plucked, and despatched for sale without delay. The nuts intended for conversion to copra are despatched to copra kilns, where they are left to dry for a month before being husked and opened. The best copra is obtained by sun-drying, but in wet weather drying is done over grill fires. The dried kernels are partly exported as copra, and partly sent to central oil mills, situated mainly within the Colombo-Kurunegala-Chilaw coconut triangle. The crushed kernel, after the oil has been extracted, forms poonac, which is an excellent cattle food, and can also be used as manure. Desiccated coconut, which is used in countries of the temperate zone for the making of confectionery, is made by grating the white part of the kernel and drying it. Elaborate mills for the production of desiccated coconut on a large scale have been set up in the same area. The husk of the coconut is converted into fibre in mills, after being soaked for some three to six months in saline water. After the soft parts have decayed, the husk is taken out and beaten. The fibre is used mainly for making mattresses, but is also used for the manufacture of bristle and yarn. Bristle is used for the manufacture of brooms and brushes, and yarn for ropes and mats. The coir industry is mainly confined to the Southern and North-Western Provinces. Coconut-shell charcoal is made by burning coconut shells in pits from which the air is excluded. The charcoal is used in laundries, bakeries and gas engines.

The production of toddy and arrack are two important industries based on the coconut palm, the Kalutara District being the special area for the distilling of arrack.

Toddy is the sap which ascends to the inflorescence as the fruit begins to form. The flowering stalk is cut and made to 'bleed', and the juice collected in a pot suspended beneath it. The juice is 'sweet toddy', and is obtained from other palms too, like kitul and palmyra. When drunk

fresh it is a pleasant and wholesome drink, but after fermentation has made progress, the sugar in it is partly converted into alcohol and it becomes intoxicating.

Arrack is made by distillation of coconut toddy. The distillation of arrack is now concentrated in nine large distilleries in the Kalutara District. There is also a State distillery at Siduwa. All distilling operations are carried on under supervision of the Excise Department. The Government stores and matures the spirit in wood, and blends and bottles the arrack.

As a food crop coconut is second only to rice, and plays an important part in the domestic economy of every household. In fact, domestic consumption and export demand are in permanent competition for the output. Although no accurate figures are available, it has been estimated that production is about 1,800 million nuts per annum and that as many nuts are consumed locally as enter into the processing and export trades. As the population increases and as local manufacture of soap and other products that use coconut oil is stepped up, an increasing number of nuts will be needed for home consumption, and progressively less will be available for export.

The following table of copra production in the leading countries shows that Ceylon is the third or fourth largest producer of coconuts.

PRODUCTION OF COPRA IN THE LEADING COUNTRIES
'000 METRIC TONS

Country	1950	1951	1952
Philippines	780	1,087	916
Indonesia	461	564	420
Ceylon	193	249	267
India	220		234
Malaya	152	163	157
New Guinea	59	56	64

In the export of oil, however, Ceylon ranks first, as the following table shows:

EXPORTS OF COCONUT OIL, '000 METRIC TONS

	1950	1951	1952
Ceylon	77	112	108
Philippines	71	77	85
Malaya	58	69	67

Ceylon's exports of copra go mainly to Pakistan and India, of coconut oil, desiccated coconut and other coconut products to the United Kingdom and other European countries, and of fresh nuts to the United Kingdom, India and European countries.

EXERCISES

1. What do you understand by plantation agriculture? Illustrate your answer by what you consider to be the leading plantation crop in Ceylon.

2. What geographical conditions influence the growing of rubber in Ceylon? Show how these conditions have determined the distribution of rubber. What prospects are there for the extension of rubber growing in Ceylon?

3. Describe the distribution and present condition of the coconut plantation industry. Compare the coconut industry with rubber and tea, and indicate its future prospects.

4. Examine the geographical factors which have promoted the development of a plantation economy in Ceylon.

CHAPTER 12

AGRICULTURE—MINOR COMMERCIAL CROPS

Other commercial crops come a long way behind tea, rubber and coconuts.

Minor Commercial Crops	*Acreage*
Arecanuts	69,000
Cinnamon	33,000
Citronella	30,000
Cacao	20,000
Tobacco	10,000
Cardamoms	6,000

Cacao is not the leading minor commercial crop in point of acreage, but Ceylon cacao ranks high in the world market, and Ceylon is the principal Asiatic source. Its acreage seems to have dwindled from 35,000 acres in the pre-war period, to only about 20,000 acres at the present day. Even so, Ceylon leads Asia in the extent of land under cacao. It is perhaps more confined to equatorial lands than even rubber. It requires a moist atmosphere with an equable temperature of about 78°F. throughout the year. As the young plants cannot stand too much sun shade trees have to be planted with them.[1] A rainfall of about 80 inches well distributed throughout the year is necessary, and protection from strong winds, which would otherwise cause premature dropping of the fruit. It is therefore grown in enclosed mountain valleys at elevations between 500 and 2,000 feet, the plantations being almost entirely in the Kandy

[1] Interplanting with rubber is a way of dispensing with unproductive growing of shade trees. A beginning has been made in this direction, and it is probable that all new planting will be intermingled with rubber or coconut.

and Matale Districts, and the adjoining parts of the Kurunegala District. The cacao tree (*Theobroma cacao*) begins to bear in three years, but does not reach maturity till it is about ten years old. From the fifth year onward two crops a year can be gathered, a small one in May-July, and a big one in November-January. After the pods are plucked, they are cut open by hand, and the seeds or beans, as they are called, placed in baskets for fermentation. In this process, the sugary pulp adhering to the seed liquefies and drains off. The beans are lightly washed and cured artificially or by drying in the sun. They are then sorted and packed for export. The beans form the raw material for the manufacture of cocoa powder and chocolate. They contain a good proportion of fat, which has to be removed in the manufacture of cocoa powder, but this by-product is put to other industrial uses. Though Ceylon cacao is of a high grade, indigenous cocoa manufacture has not been too successful, as local manufacturers have not yet learnt the proper technique of palatable cocoa production. This is obviously an instance where the government should invite foreign capital to open a cocoa manufactory in the country. As Ceylon's cacao ranks high in the world market, there is much scope for a successful enterprise of this nature.

Our annual exports of cacao average 50,000 cwt. and go chiefly to the Philippines, Japan, Great Britain and other European countries.

Cinnamon needs a hot moist climate and an annual rainfall of about 80 inches, with a light sandy surface soil overlying a heavier clay. It is thus grown only on the coastal strip of the south and west. Formerly one of Ceylon's main exports, it has now fallen from its high estate, not from any diminution of its excellence, but as a result of improvements in the technique of methods of food storage and preservation. Nevertheless, Ceylon

remains the world's chief source of this spice. Even in Dutch and early British times, plantations were encouraged and controlled by the State as an important means of revenue. A great number of these were in or near Colombo, whence the name, 'Cinnamon gardens' applied to what was once a large cinnamon plantation, but has now become one of the chief residential suburbs of the city. The majority of plantations are now in the Negombo and Galle Districts. They are mostly 10 to 25 acres in extent, though there are a few plantations of over 100 acres.

In its wild state the tree grows to a height of thirty feet, but when cultivated, it is lopped to a height of about ten feet and made to produce long slender shoots. The fruit ripens in April, and if the tree is bearing well, it is considered fit for cutting, since then the bark will peel easily. The shoots are then cut and removed to the peeling stores, where the bark is removed in long strips by a specially trained caste of people—the Challias. The strips are allowed to ferment for a while, after which their outer skin has to be removed. The fermenting process is completed after this, and when the bark is dry, it is rolled into quills or rods, and tied into bundles for export. Cinnamon oil is obtained from the leaf as well as from the bark. Exports of cinnamon go largely to Mexico and U.S.A., and of oil to U.S.A. and U.K.

Citronella is obtained from a cultivated form of 'mana' grass. It thrives well in the hot moist conditions of the wet zone up to an elevation of 2,000 feet, but will grow quite well under as low a rainfall as 50 inches, and on the poorest of soils. Its cultivation is accordingly confined to the drier parts of the Southern Province, where coconut cultivation begins to thin out, as in the Matara and Hambantota Districts. Cultivation has hitherto been carried out in a haphazard manner by the Sinhalese peasant. The grass is propagated by vegetative division, and is planted

in rows two feet by three apart. The grass is cut twice a year, and crude distilleries press out the oil, which has a strong aromatic odour. The annual yield per acre is about 40 lbs. of oil. It is exported to U.S.A., U.K. and Europe for use in scenting soaps and perfumes, and also as an ingredient in insecticides. Of recent years there has been a decline in production, due to a falling off in price and competition from Java and Formosa. If the industry is to be saved it will be necessary for the quality of the product to be improved and standardised.

Tobacco is a crop that grows under a wide range of climatic conditions, ranging from the Equator almost up to Latitude 40°. Soil and aspect are of more importance than climate. Its cultivation is an industry for which there is much scope in Ceylon both for improvement in quality and extension of acreage. Various types have been cultivated in Ceylon for the last two or three centuries, but the greatest development has been in the Jaffna Peninsula, where over 4,500 acres are cultivated to produce a coarse leaf of a strong flavour, which suits the taste of the local population, and similar peoples in South India and Malaya. This leaf is used for local cigar manufacture and also for chewing, a considerable market for the latter having been developed in Travancore. The decline of this trade, however, has led to the exploration of the possibilities of lighter varieties with a more delicate flavour, and those suitable for cigarette manufacture. In other parts of the country, however, such as the Dumbara valley and the Kurunegala District, lighter tobaccos have been cultivated. Other areas are Batticaloa, Eravur, and Tamankaduwa, and Hanguranketa, Nildandahinna and parts of Matale. In 1953 Ceylon imported no less than Rs. 6,000,000 worth of tobacco. Consumers prefer the imported variety for its quality, and the quality of the local product can reach this standard, given the requisite technical knowledge and financial help.

Another urgent need is an organised market. In recent years trials have been conducted to determine the particular soils and districts where certain varieties of Virginian tobacco could be grown. Successful experiments at the Hingurakgoda State farm showed that cigarette tobacco could be profitably grown on paddy lands in the dry zone, whenever sufficient water for growing paddy was not available. About 2,000 acres of this variety known as Harrison's Special are already under cultivation in the Dumbara valley and parts of the North-Western Province. As there is a good market for this tobacco, which is used for all cigarettes manufactured in Ceylon, it has been decided to encourage the cultivation of this variety. Experiments in Jaffna too have shown that certain areas, e.g. Tellippallai, Uduvil and Nirveli are suitable for cigarette tobacco, and certain cigarette companies have established buying floors at the growing centres to ensure that the cultivators get better prices for their produce by the elimination of the middleman. Trials carried out by the Department of Agriculture have also shown that certain imported varieties of cigar tobacco could be advantageously grown in certain districts, if the farmer is educated to be sparing in his use of water.

The Ceylon Tobacco Company is the leading manufacturer of cigarettes in the country, and owns tobacco plantations around Hanguranketa and in the Kurunegala District. In Jaffna the company advises owners of tobacco lands. The company uses both locally grown tobacco and the imported varieties in its manufacture of cigarettes.

Cardamoms are grown only in parts of the hill country which have a rainfall of over 115 inches a year. The plants which grow in clumps require a mean temperature of about 72°F. and shelter from the direct rays of the sun. They are accordingly grown under the shade of other trees, mostly in European estates, but a fair proportion of the

total acreage is found in smaller peasant holdings. The fruit is borne on special branches which spring directly from the ground. Over three-quarters of the total acreage is in the Central Province, and the remainder in the Kegalla and Ratnapura Districts of Sabaragamuwa.

Arecanuts.—Though the acreage under arecanuts is much larger than those under the other minor commercial crops, the palm is not systematically cultivated. This graceful palm thrives up to an elevation of about 2,500 ft. in the wet zone, where it may be found in every village garden. The Kegalla District, however, has some fairly extensive pure plantations. The tree produces prolific clusters of fruit, whether it receives much attention or not. Apart from meeting the needs of the local market, arecanuts are exported to India and the Maldive Islands.

Among other money crops less systematically grown, are cotton, kapok, papaw, pepper, pineapple and coffee.

Cotton, which was grown mainly in chenas before the war, is a crop that can be grown as a rotation crop in the dry zone. The chief obstacle to successful cotton growing in Ceylon is excessive or unseasonable rains, as these prevent proper ripening of the bolls. The cotton of commerce is a shrub, which though perennial in tropical countries, is grown as an annual. The Hambantota District is the chief area where it has been tried. About 3,000 acres were under cultivation in 1951, and yielded 7,842 cwt. of seed cotton. The Wellawatta Spinning and Weaving Mills buys up the entire crop.

Kapok, the fibre of which is too short and brittle to be woven, but is suitable for stuffing pillows and mattresses, is grown as a hedge plant and sometimes interspersed with other cultivation. It grows everywhere in the wet zone up to an elevation of 2,500 feet.

The *papaw* too grows everywhere in the wet zone, with smaller varieties in the higher parts of the hill country.

Apart from its market value as a table fruit, the extraction of papaw milk, which is dried to form papain, is a profitable peasant industry carried on particularly in the Kegalla, Kandy, and Kurunegala Districts.

Pepper thrives in the mid and low country wet and semi-dry zones at elevations up to 1,700 feet. The Matale and Dumbara valleys are the chief pepper-growing areas. The pepper vine is generally trained on hedge trees in village gardens or shade trees in tea and cacao estates. In village gardens the vines are also allowed to climb on trees such as jak, mango and arecanut. Crops can be raised from the third year, the yield gradually increasing to a maximum between the eighth and twelfth years. The plant flowers in October, and the crop ripens between March and May. Black pepper is the whole fruit dried with the skin, and white pepper is obtained from the skinned fruit.

Pineapple grows best in the low country to the north and north-east of Colombo in the area lying between Gampaha and Madampe. Though fairly resistant to drought, it requires a well distributed rainfall for good growth. It grows well on a wide range of soils from lateritic gravel to sandy loams, but clayey loams are unsuitable, as the pineapple is not tolerant of poor drainage. Formerly only the local market was supplied, but now the fruit is also canned and exported. New Zealand is the chief buyer. A canning factory is being built at Narahenpita.

Coffee.—A very small amount of coffee is grown in a few gardens in the Kandy and Matale Districts and elsewhere. Coffee planting, commenced by the British in 1823, reached its zenith in 1872, but a succession of economic crises and finally disease, in the shape of a minute fungus, *Hemileia vastatrix*, succeeded in completely destroying the industry by 1890. These original plantations were of *Coffea arabica*. The species now grown, *C. robusta*, is much more resistant to disease, but is of a less delicate flavour.

Cinchona.—Shortage of quinine during the last war led to the Government establishing a plantation of 125 acres of cinchona on the southern slopes of the Central Plateau at Massena near Balangoda. The discovery of newer remedies for the eradication of malaria, however, makes the revival of the cinchona industry a questionable policy.

EXERCISES

1. Name four of the leading minor commercial crops of Ceylon. Select two of these, and for each state the geographical conditions that favour its production. Examine the possibilities of extension of cultivation or production.

2. What geographical conditions affect the production of (a) tobacco, (b) cotton (c) sugar-cane in Ceylon? Describe the efforts made to cultivate each in recent years.

CHAPTER 13

FISHERIES

Though Ceylon has a fairly extensive coast line of about 800 miles, the fishing industry is in a rather undeveloped and backward state. In general the lot of the fishermen is a hard one. They have been traditionally at the mercy of the capitalists who finance them and help to dispose of their catch. The result is that the poor fishermen get but a fraction of the price ultimately paid by the consumer.

There are in all about 70,000 fishermen distributed along the entire coast, but mainly in the northern half of the Island. As the chief market for the fish is in Colombo, and the densely inhabited south, transport is one of the main problems, and lack of refrigerated storage the other. Since 1941, the State has made efforts to help the industry. Groups of fishermen were organised into Co-operative societies, to whom the Government gave financial assistance. During the war years the Government stepped in at certain centres to purchase and dispose of the catch at fixed prices. Apart from helping the fishermen, the opening of government fisheries stalls in the big towns helped to keep the price of fish from rising to exorbitant heights in the open market, and thus the consumer was benefited.

The chief branch of the local fishing industry is that of sea-fishing, and this has been carried out in the most primitive type of craft—the outrigger canoe and the cattamaram. Such craft can neither follow a shoal for any length of time, nor hold more than a very small catch. In the northern and eastern parts, the vallam takes the place of the outrigger canoe for deep-sea fishing.

The common net used in Ceylon is the shore seine. This is a fishing net for encircling the fish. It has floats at the top and weights at the bottom edge. More generally one boat, but sometimes two cast the net about half a mile from the shore, and the net is then hauled ashore by the two ends. The majority of fish caught by this method are

[*Courtesy, Department of Fisheries.*

FIG. 61.—Vallams—Jaffna Lagoon.

shoaling fish. This method is common on the west coast during the North-East Monsoon, and on the east coast during the South-West Monsoon.

Outrigger canoes venture into deeper water, and use lines for catching larger fish like the seer, shark, albacore (S. kellawella), etc.

The cattamaram is common north of Colombo. This is a raft composed of four logs, lashed together and used with a sail. Drift nets are used on these, and the

cattamaram drifts with the nets on its leeward side. The drift nets are held in front of the cattamarams. They hang like curtains in the water and trap surface swimming fish.

Trawl fishing has been carried out with one or two trawlers by the Government Fisheries Department. The trawl is a large bag-shaped net, which is drawn over the ocean floor and scoops up the fish as it moves forward. The immediate sea floor off the Ceylon coast is too rocky for trawl fishing. The only suitable grounds are the Wadge Bank off Cape Comorin, some eighteen hours steaming from Colombo, and Pedro Bank, a few hours from Point Pedro. On account of their distance, these can only be exploited by power-driven ships equipped with refrigerating machinery and ample storage space, the ships having perforce to remain out at sea for several days.

Ceylon's total catch averages about 40,000 tons per annum. Of this only about 23,000 tons are sold as fresh or frozen fish; the rest has to be salted and dried, or converted into fish meal and manure. The average quantity imported is also nearly 40,000 tons, so that Ceylon needs to double its production in order to attain self-sufficiency.

In an effort to increase the catch, the Government has invited experts to report and make recommendations for the improvement of the industry. Among the recommendations made were—

(1) The extension of trawler fishing,

(2) The use of a mother ship to tow a number of fishing boats out to the fishing grounds, and then bring them back with their catches;

(3) The introduction of motor fishing boats;

(4) The fitting of engines and outboard motors to local craft;

(5) The construction of ice-plants at various fishing centres;

(6) The setting up of a central fish-curing yard at Muturajawela to reduce the huge import of dry-fish and Maldive fish;

(7) The establishment of a research station for the study of the life history, spawning and migratory habits of the edible species.

Some of these recommendations have been already adopted, but their success has not been unqualified. With regard to trawl fishing it has been pointed out that—

(1) A trawler can do only three trips a month, and that for only ten months in the year, the other two months being taken up in repairs and servicing. Thus it cannot bring much more than an average of 650 tons of fish per annum.[1] Ceylon cannot hope to operate more than three trawlers—two on Wadge Bank and one on Pedro, assuming that an equal number may be operated by India.

(2) Trawler fishing requires heavy investment.

(3) Trawlers catch mostly second grade fish.

(4) As an occupational outlet it cannot absorb more than a handful of men.

The use of mother craft has been popular in the northern parts of the Island, but has proved too costly, and most fishing societies were reluctant to hire them at the Department's price. Regarding the other recommendations, assistance is being given by the United Nations' Food and Agricultural Organisation (FAO), and also by Canada under the Colombo Plan. This includes equipment for storing trawler catches, a workshop for repairing trawlers and fishing boats, and equipment for processing fish.[2]

The other branches of the fishing industry are of much less importance, and fall into the following groups: (1)

[1] One of the government trawlers which ultimately had to be scrapped averaged only 360 tons.

[2] A new fishing company (Ocean Foods and Trade Ltd.)—a joint Ceylonese and Japanese venture, was formed in 1955, with the intention of augmenting the fish supply by fishing in distant waters.

Prawn Fisheries, (2) Fresh Water Fisheries, (3) Chank Fisheries and (4) Pearl Fisheries.

Prawn fishing is done mainly in the lagoons. Recently attempts have been made by the Department of Fisheries to encourage prawn culture. The prawn hatches out in the sea, and then migrates into the lagoons to remain there till it has reached a size of about four inches. At this stage it returns to the sea. Traps are used to capture prawns which go out with the tide from the lagoons into the sea. The technique of attracting prawns into prepared enclosures in lagoon areas, and keeping them there till they grow to marketable size is one that can be introduced to increase the supply, as is done on the Malabar coast and in Malaysia. Excellent prawn grounds are found at Negombo, Puttalam, Mannar, Punnalai, Batticaloa and Trincomalee.

Fresh water fisheries.—These are carried out by peasants in the tanks and rivers, and form a valuable supplement to their diet. But local fresh water fish are not held in general esteem on account of their muddy flavour, and attempts have been made to breed certain varieties of carp and tilapia which have proved successful in Malaya, Indonesia and Thailand, and other Asian countries. They are first stocked in the Department's ponds at Galle Face, and when they reach maturity, they are distributed to certain other pools specially constructed for breeding in the neighbourhood of large water areas, which have been declared as fish sanctuaries for specified periods. From these the fish have been let out into the rivers and elas from time to time to serve as a by-product from the paddy fields. Tilapia multiplies with extreme rapidity, and is fast becoming one of the food staples of the interior of Ceylon, as it has done in Thailand. Other fish which have proved successful are the giant and dwarf gourami. Polonnaruwa has been chosen as the main centre for developing fresh water fisheries.

Chank fisheries.—The chank of Palk Strait is a shell fish whose shell is used to make cheap bangles. The market for these is chiefly in Bengal, but as a result of India's ban on the import of chanks from Ceylon, there have been no fisheries since 1949.

Pearl fisheries.—The pearl oyster occurs periodically in great abundance on the pearl banks off Marichchukkaddi in the Gulf of Mannar. The pearl is a protective secretion made by the pearl oyster against an irritant introduced into its body. Pearl fishing, which is a government monopoly, is carried on at irregular intervals whenever oysters are abundant. A pearl fishery lasts for about forty days, and is usually conducted in February and March.

The 'paars' or banks on which the oysters occur lie over ten miles out to sea, and at depths varying from four to twelve fathoms. The paars are inspected about four or five months ahead to give notice of an impending fishery, and another inspection is carried out shortly before the opening day to make certain that the oysters are still there. If they are, and a sample collection shows that a percentage of them contains pearls, the starting day will be confirmed, and an entire fishing fleet, two to three thousand divers, mainly from South India, and merchants from all over the East will descend upon Marichchukkaddi, to make this lonely and desolate spot a roaring camp almost overnight. Usually the divers are given about one-third of the haul, and the rest is put up in heaps for auction by the Government. Huge bids are made at these auctions mainly by Moors, and as nobody knows what the pearl content of the molluscs will be, the purchase is quite a gamble.

After an inspection in the previous December the Government announced a fishery for February 1952, but when February came round, the oysters had mysteriously disappeared and the fishery could not be held. The last fishery was held in 1925, when over fifteen million oysters

were fished, on which the Government collected gross proceeds of over half a million rupees. It is unfortunate that the survival of such a profitable industry should be left to chance, without any attempt being made (1) to ascertain the cause of the disappearance of vast beds of oysters in so short a time, (2) to work out methods of artificial culture, or of segregation of natural oysters in enclosed water areas. However, net profits from pearl fisheries are not very high, as the expenses of survey, camp construction and maintenance are so heavy.

The window-pane oyster is an oyster that occurs naturally in such enclosed areas like Lake Tambalagam, Trincomalee, but its pearl is of an inferior quality. Fishing was suspended during the war, but was resumed in 1949 and 1951. Six million oysters were taken in 1951, and yielded a revenue of Rs. 18,000.

EXERCISES

1. State the conditions favourable to the development of large-scale marine fisheries. Point out how far these obtain in Ceylon, and indicate the possibilities, if any, of future expansion.
2. Describe the present state of development of the fishing industry in Ceylon.

CHAPTER 14

MINERALS

Mineral products come far behind vegetable products in quantity and value.

Graphite.—Ceylon's chief mineral is graphite or plumbago, the deposits of which are reputed to be the largest in the world, and of the highest grade. Ceylon's graphite has been mined from hundreds of mines—at one time in 1941 there were over 2,000, but the number varies considerably from time to time, depending on the demand and the market prices. The peak was reached in 1942, when over 27,000 tons were exported. Since 1948 the export has averaged 12,000 tons, valued at Rs. 6,000,000, but in 1952 the quantity exported dropped to 7,600 tons.

The geological distribution of graphite seems to be confined to the Khondalite system of rocks. Though the Khondalite system is widely distributed, the chief mining centres may be roughly grouped into two areas:—

(1) The Ruwanwella-Kurunegala area in the west-centre;

(2) The Kalutara, Galle and Morawaka areas in the south-west.

Though plumbago occurs widely as disseminations, the main workings are from vein deposits, which are the only ones that can be profitably worked. It is also probable that extensive vein deposits occur elsewhere in the Khondalite rock system than in the areas worked at present. One such area is the quadrilateral whose corners are at Vavuniya, Horowupotana, Dambulla and Nikaweratiya. In an area so thickly covered with Pleistocene and more recent alluvial deposits, we cannot expect to find surface outcrops of graphite veins so common in the Galle and Kalutara Districts.

The methods of mining are generally of the simplest nature—opening out of pits, open-cast trenches or adits

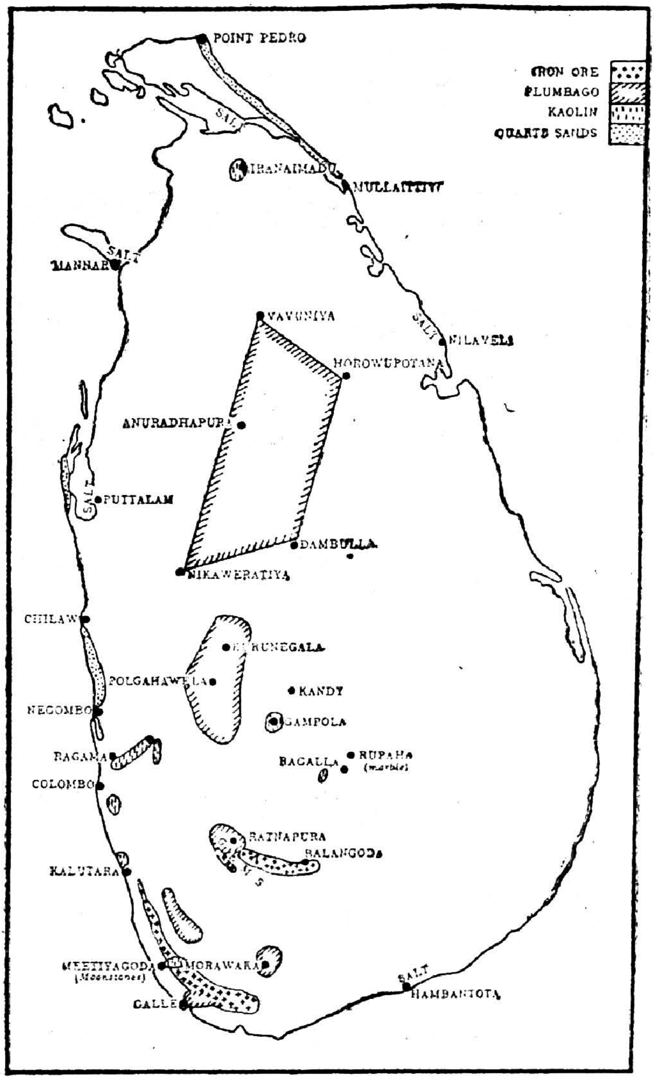


Fig. 62.—Mineral Resources of Ceylon.

on any promising outcrops, and pursuing the ore body as long as it holds out. In this way single shafts with a

few lateral drives at one or more levels are carried out to a depth of eighty or hundred feet. There are a few large mines, the best known of which are the Bogala mines near Ruwanwella, and the Ragedera and Kahatagaha mines in the Kurunegala District, the last having a depth of 1,600 feet. Mechanical haulage is provided in these, and the underground workings are electrically lit. Lifts take the miners down and up the shafts, and trolleys on rails convey the crude mineral to the foot of the shaft, and again from the entrance of the mine to the curing shed.

The amount of plumbago mined so far is quite insignificant in comparison with the total reserves. Plumbago is used in the manufacture of crucibles, furnace facings, lubricants, paints, pencils, etc. It is a pity the country has not tried to use part of its output for local manufacture of some of the goods for which high grade graphite is necessary; or at least to subject the ore to some sort of refining and processing to fit it for particular manufactures, which would add several hundred per cent to the price of the raw material. The country seems to be frittering away a valuable national asset for a disproportionate immediate gain.

Precious Stones. The gemming industry of Ceylon is one of great antiquity. It is surprising that after so many centuries of exploitation the gemfields do not show much sign of depletion. The chief gem bearing area is the Ratnapura District, where gems are obtained from alluvial gravels extending from Avissawella to Balangoda with centres at Pelmadulla and Ratnapura. Sapphires are the most valuable, but there are a great variety of other stones, such as amethysts, topazes, cat's eyes, garnets, spinels and moonstones. Some gems are also obtained in the south-west, roughly within the triangle Ambalangoda, Rakwana, Matara.

The mining methods are primitive, and consist of digging of pits about twenty feet deep until a gem-bearing

gravel called 'illam' is reached. This seems to be some former river bed.[1] The gravel is taken up and stacked in heaps, to be washed later in sieves. Methods of washing

[P. G. Cooray

FIG. 63.—Gem pit, Pelmadulla.

are also capable of much improvement. The stones when found are rough and unattractive in appearance, and quite unlike the finished product when cut and polished by the gem-cutters or lapidaries. Gem-cutting is a fine art, and is carried on at Ratnapura, Pelmadulla, Galle and Matara by Muslim lapidaries. Moonstones are worked only at Meetiyagoda near Ambalangoda. The annual value of gems produced is about Rs. 2,000,000.

Salt.—Salt is obtained by the evaporation of sea water

[1] This method is extremely wasteful, as the entire gem-bed is not explored, and the area that lies between the pits is not worked. Besides, more than one *illam* lies underground, but the gem-workers, in their ignorance of this, stop work after exploring the top layer. More scientific hydraulic mining would ensure that the whole layer is exhaustively worked, as well as the layer or layers underneath.

in shallow enclosures bordering the lagoons of the arid zone, e.g. at Elephant Pass, Puttalam and Hambantota, the Elephant Pass salterns having the largest output. The conditions favourable to salt production are: (1) low rainfall, (2) a long dry season, and (3) the prevalence of strong steady winds. In the past the annual production has fluctuated very much, as is shown by the following figures:—

SALT PRODUCTION IN CEYLON

Year	Quantity (tons)	Year	Quantity (tons)
1939	35,559	1946	42,920
1940	33,264	1947	22,791
1941	28,061	1948	77,429
1942	18,383	1949	28,220
1943	13,563	1950	66,859
1944	28,233	1951	25,834
1945	41,695	1952	45,300

Attempts are being made to smooth out these fluctuations, and generally increase production sufficiently to leave a surplus for export. Plans have been drawn up not only to extend the capacity of the salterns, but also to utilise the various by-products of salt manufacture, and thus reduce the cost of production. Among the by-products are gypsum (used in the manufacture of plaster of Paris, cement and school chalk) and magnesium and potassium salts. In the opinion of U.N. salt experts, the Jaffna Lagoon at Elephant Pass, if enclosed by a dam, could be made to provide enough salt for all South-East Asia, and they have recommended the location here of factories for allied products, such as caustic soda, chlorine and the washing and baking sodas, but the absence of a port at the point of manufacture, as well as the lack of cheap power, militates greatly against production at a competitive price. The

World Bank Mission[1] recommended a location within range of the Hydro-Electric grid, such as Puttalam.

Kaolin.—Very large resources of China clay, only a few feet below the surface, have been located in many parts of the Island, but particularly in the south-west. The chief of these is the Kalubovila-Boralesgamuwa field, the reserves of which have been estimated to be ten million tons. Other deposits occur in belts, e.g. from Ragama to Gampaha, from Weke to Attanagala, and at Gampola, Nuwara Eliya, Kalutara, Iranamadu and Meetiyagoda. These deposits only require refining and can supply not only local ceramic industries, but are abundant enough to form the basis of an export trade, especially if the clay is refined, as this would both enhance its value and reduce freight costs. The principal use of kaolin is in the porcelain industry, but it is also used as a filler for paper to give it body and a smooth surface. It is also used as filler in the rubber industry, and as a stiffener in cotton and other textile fabrics. Other uses are for paints, special cements and pharmaceutics.

Ordinary clay suitable for making pots and pans and the common cooking utensils, and brick-earths and tile clays are widely distributed, being found in all the river valleys and paddy fields. When an excess of such silts and clays has accumulated in any plot of paddy land, it is got rid of by being moulded into bricks and burnt in crude kilns *in situ*. These are a common sight in the Colombo and Kandy Districts.

Quartz sands.—Extensive deposits of high grade glass sands containing over 98 per cent silica occur at several

[1] See Report of the International Bank for Reconstruction and Development on 'The Economic Development of Ceylon'—Ceylon Government Press, 1952, Vol. II, pp. 272-3. The Government has recently decided to help salt manufacturers in Puttalam to form themselves into a corporation to tap the salterns in the district to a maximum.

localities along the coasts, e.g. at Marawila, Kalpitiya, Chavakachcheri and south of Point Pedro. They contain traces of iron and ilmenite, which should be removed before the sand is used in glass manufacture or for export, as they give an undesirable dark colour to the product.

Iron ore is found in several well defined localities mainly in the south-west sector of the Island. The chief of these are:—

(1) A belt running from Ratnapura through Dela and Kahawatta to Balangoda;

(2) A belt about four miles inland from the south-west coast, running from near Kalutara to Baddegama, and from there to Akuressa.

Other deposits occur near Ruwanwella, Kandy, Matale and Chilaw. The total reserves are only about six million tons, averaging about 50 per cent metal. The scattered nature of the deposits and lack of surplus hydro-electric power make it uneconomic to work this ore at present.

Ilmenite is the ore of titanium, which in the form of titanium oxide is used as a base for superior paints, in ceramics and in the manufacture of special steels and alloys. Though widespread in nature, concentration of ilmenite grains occurs only when, transported by running water, they are carried to the sea, where under the sorting action of currents and tides they form beach deposits of a semi-permanent nature. Observation seems to indicate alternate enrichment and impoverishment with the seasons in the shallow margin between tidal limits. Deposits occur at Pulmoddai, 35 miles north of Trincomalee and at Tiruk-kovil, 45 miles south of Batticaloa. The former are much more extensive, but has no proper access by road, while the latter are of lower grade. Requests by private concerns for mining concessions with royalty payments to Government have so far been refused, on the ground that they planned to ship the ore for refinement elsewhere. It is now pro-

posed to withdraw this restriction and call for tenders again. These deposits also contain zircon and rutile.

Radioactive minerals.—Monazite also occurs in beach concentrates, often associated with ilmenite. Isolated deposits occur at points on the west coast, e.g. at Kaikawela near Induruwa, north of Beruwala near the 34th mile post, and at Kudremalai. About 450 tons of refined monazite were exported between the years 1918 and 1922. A pilot factory was set up in 1952 at Katukurunda to recover monazite from the west coast beach deposits. Small quantities of thorianite have also been detected in these deposits. Thorianite was first detected in the heavy residues obtained from the washing of stream gravels in the Bambarabotuwa valley in the Ratnapura District, and subsequently at Maddegama in the Galle District. Between 1904 and 1910 nearly nine tons of this mineral were exported at a price of over £1,600 a ton, and the deposits were believed to have been exhausted. Since 1945 fresh deposits have been discovered in the Bambarabotuwa area, and also in a few other localities such as Pelmadulla and Mitipola. Because of the increasing demands for radioactive minerals, it is likely that it may become profitable to work these. Some of these thorianites contain appreciable quantities of uranium.

Mica is found in several localities, but the size of sheet obtainable has been too small to encourage anything but haphazard and occasional working. Deposits have been located at Naula, Matale, Polgolla (Kurunegala District), Mailapitiya, Balangoda, at Dikwellagama near Badulla and at Kirigalpotta near Passara.

EXERCISES

1. Give a summary account of the resources and annual production of minerals in Ceylon.
2. To what extent do you think it possible for industrial development in Ceylon to be based on local mineral resources?

CHAPTER 15

MANUFACTURE AND INDUSTRY

Before the Second World War manufacturing industry in Ceylon was mainly concerned with the processing of the various agricultural products for the market. Thus the tea estates had their own machinery for turning out the finished product, while the rubber estates produced their own sheet and crepe rubber. Rubber manufacture in pre-war years did not proceed beyond that stage in Ceylon. For coconuts there were oil mills using hydraulic presses and expellers, and also mills with elaborate machinery for the production of desiccated coconut on a large scale. In the coconut districts to the north and east of Colombo are also several fibre mills for the manufacture of coir. To the south of Colombo in the Kalutara District were located the chief distilleries for the manufacture of arrack out of coconut toddy, while the preparation of fibre as a cottage industry, for making of mats, brushes and ropes, is also carried on along the south-west coast. The Spinning and Weaving Mills at Wellawatte were the sole manufacturers of cotton goods, though there is a certain amount of handloom production in Batticaloa, Jaffna and several other centres. In South Batticaloa, at Kattankudi, about 1,500 weavers carry on their occupation in abject poverty and depend on imported yarn. Handloom textile production is a widespread occupation, about 4,000 looms being worked by about 8,000 weavers. As it is estimated that as many as 10,000 looms and more than double that number of weavers are often idle for lack of yarn, the Government proposes setting up a spinning mill. But any such project will be economically sound only if more cotton can be grown in the Island, for at the present moment the

Wellawatte mill is able to utilize much more cotton fibre than is available locally. Most of the other industries were home industries carried out in special locations. Thus Kalutara is famous for baskets and hats woven from the leaves of the Indi, or wild date-palm, Panadura and Batticaloa for the weaving of mats from various rushes, Moratuwa and Ambalangoda for carpentry, Kandy for kitul jaggery and brasswork, and Galle for coconut jaggery and tortoise-shell ware. Dumbara mats are made of fibre obtained mainly from the bowstring hemp (*Sinh.* Niyanda), but fibre from other plants, such as Mauritius hemp (*Sinh.* Hana-gas) and Sansevieria guineensis (*Sinh.* Polon-hana) is also mixed with this.

Ceylon lacks most of the basic requirements for modern heavy industry. She has no coal nor adequate supplies of any other power, and her resources in iron ore are quite small. Unlike India, she has no reservoirs of suitable labour. Transport facilities are lacking in most parts, and her limited supplies of capital have so far found an adequate investment in the staple agricultural industries. To supply the equipment for the agricultural industries, there developed engineering and machine-making trades which arose first from the need for keeping the machinery in repair, and subsequently expanded to manufacture the machinery. There has also been a gradual development of small factories turning out such goods as cotton vests and shirts, aerated waters, beer, safety matches and soap. Under the influence of war-time scarcities, a number of temporary industries were set up, and a need for the diversification of the economy of the country began to be realised. Even when the war was over, the restrictions on trade due to exchange control, lack of shipping space, the uncertain prices in the world markets of Ceylon's main exports, and a disproportionate rise in the prices of imports, made it necessary to look for means of making Ceylon more

self-sufficient. On the one hand, it was necessary to increase food production, on the other, industrial development would enable Ceylon to process raw materials like rubber and copra, and thus increase wealth and provide more employment. The State was to encourage industrial development by (1) sending suitable persons abroad for training, (2) conducting industrial surveys to establish major industries, (3) investigating the possibilities of potential industries, (4) creating and sponsoring institutions that offer long-term and medium-term credit facilities at low rates of interest, and (5) granting protection to local industries in the form of fiscal assistance. Certain industries such as power, iron and steel, cement and heavy chemicals were classed as basic industries, and were to be run by the State, and other industries, considered to be non-basic, were to be left open to private enterprise.

All the factories set up by the Department of Commerce and Industries during the War years lacked proper equipment, and most of them were technically unsound and uneconomical even at the outset. The absence of foreign competition, however, enabled them to appear as profit making concerns till 1945. Thereafter the Department's monopoly was broken, and the factories began to show losses. The losses came to a head in 1950, when after much deliberation, it was decided to close down the uneconomic factories. The factories that had to be closed down were the paper factory at Kakkapalliya, the acetic acid factory at Madampe, the glass factory at Nattandiya, ceramics[1] at Negombo, coir at Katunayaka and the steel-rolling and drugs factories at Colombo. Of the factories still operating, the plywood factory at Gintota and the leather factory at Mattakuliya were to be reorganised. Meanwhile

[1] The ceramic factory is being re-built and re-equipped, and will begin production shortly as a public corporation.

a cement factory was opened at Kankesanturai in 1950, and a number of other factories are in various stages of construction. It is clear, however, that Government management of industrial undertakings causes unnecessary overhead expenditure which prevents these undertakings from being run at a profit. Government regulations are too inherently slow and cumbersome for the day to day running of business concerns. It has therefore been proposed to convert all State industrial undertakings into corporations, where responsibility for efficient management could be left to competent managers chosen by a board of directors, the State confining itself to the rôle of stockholder and recipient of dividends. A central institute of scientific and industrial research is to be set up, to supply confidential teachnical advice to manufacturers, to do research on improving the quality of local manufactures, to develop new products and to find uses for waste products. It is to deal with such industries as were not catered for by the research institutes already in existence.

The World Bank Mission, which was invited to report on the economic development of Ceylon, commented unfavourably on several of the proposed factories.[1] In particular, it recommended the long deferment of the proposed steel, fertilizer and paper factories. In view of the fact that most of the coconut oil factories are underutilized, it considered the proposed vegetable oil factory at Siduwa a sheer waste of public funds. 'Government should give assistance to improve existing plants rather than erect a new and redundant plant. While active government encouragement of industrial development was very necessary, direct government management of factories should be avoided. The Government should encourage the training of skilled workers and technologists. It should give greater financial support to basic studies of resources.

[1] Opus cit.

In this connection, the Geological Survey of the Island should be intensified. In general, industries should be chosen which do not demand large amounts of power, fuel or fresh water. They should be based on local raw materials, but should not be started unless there are good prospects of commercial success. As for what raw materials are at hand, in the absence of adequate research and measurement, the most expert opinions on this subject are nothing more than educated guesses.' Initially, they should be small industries, which will not call for unusual amounts of skilled labour, but will only involve skills that are comparatively easily acquired. As such, they will contribute to the gradual spread of industrial techniques, which are at present so deficient in Ceylon.

Only about 50,000 people are engaged in the various manufacturing industries. More than half of the industrial establishments are concentrated in the Western Province, and these are mainly in the Colombo District or along the coast.

The *Plywood Factory* at Gintota was started in 1941, primarily for the production of tea chests from local timber, and was intended to produce one-tenth of Ceylon's requirements in this respect. The factory has passed through the usual vicissitudes attendant on government management. By 1948 wastefulness in utilization had made timber a big problem, in 1951 output fell off because of glue trouble, and by 1952 sales dwindled as a result of foreign competition, so that in 1953 tea chests had to be brought under the Industrial Products Act in the ratio of 1 local chest to 5 imported ones, and the factory had to be reorganized and re-equipped.[1] It is expected to increase the production capacity to six million square feet per annum, and also to

[1] The Industrial Products Act of 1949 gave legislative protection to articles brought under the Act by requiring dealers to purchase a certain quota of a locally manufactured product before obtaining a licence to import its foreign counterpart.

produce decorative panels and veneers of the more expensive Ceylon woods for which there is a firm demand in foreign markets.

The Cement Factory is located at Kankesanturai, where the chief raw material, limestone, is available in abundance, and clay is brought from Murunkan, near Mannar, by rail. Gypsum, the other raw material, is imported from abroad. However, the latter forms only 3% of the finished product, and might conceivably be obtained locally, when the capacity of the salterns at Elephant Pass is stepped up. The factory has been sited adjoining a limestone quarry, which has reserves estimated to be sufficient for 25 years. Other land adjoining the quarry, but privately owned, also has rich limestone deposits, and can be acquired by the government when the need arises.

Work at the factory and the quarry proceeds all day and night in three shifts of eight hours each. During the night the quarry is floodlit by high powered electric lamps. The power for these lights and for the factory is obtained from a power station about 1½ miles away, worked by diesel oil. It has a capacity of 4,000 kw., and supplies light to Jaffna town as well. The factory uses a single kiln, and was designed to produce 100,000 tons of cement a year, or nearly 300 tons a day, but on few days has the actual production exceeded 225 tons. Also because of strikes and other troubles, the factory had to be shut down for various periods.

Though preference for foreign cement is general, the factory gets orders for much more cement than it can supply. Not only is the effective factory capacity far below the demand, but shortage of railway wagons prevents movement of all the output. However, because of the increasing demands for cement, the Ministry of Industries has decided to build a second kiln and double the output, while legisla-

tion is being drafted to enable a corporation to run the factory.

The leather industry. The tanning of hides is carried out in sixteen private tanneries and one government factory at Mattakuliya. The private tanneries each handle about 3,000 cattle hides a month, while the State tannery treats about 2,500 cattle hides, 5,000 goat skins and 100 buffalo hides a month. Tanning methods are primitive. The skins are first placed in liming tanks, and lime applied to every part of the raw skin. The skins are then taken out, and the hair and particles of flesh left on the skin removed by means of specially made curved knives. After the skins are completely de-haired, they are washed several times and then immersed for a week in wattle extract. This is followed by three or four days treatment in a bath of gall nut extract to remove marks and stains and improve the colour. About 25% of the output of the state tannery is chrome-tanned in drums, the rest being wattle-tanned as in the private tanneries. Only the government tannery undertakes chrome-tanning, which gives polished leather. The privately owned tanneries manufacture only crude leather. Local hides and skins are of poor quality. Apart from numerous butcher cuts and holes, the most serious defect results from branding. However, the private tanner suffers most from this, as, after he has obtained his hides from the butcher, he has to allow the state tannery agents to select the best from his stock. He only tans the remainder, the best of which he exports to the United Kingdom as low or medium grade leather on a permit which he obtains from the government. The output of the state tannery is mainly utilised by its shoe-making section for footwear, suitcases and other miscellaneous articles, while the surplus tanned hides and skins are exported. About 25,000 pairs of shoes are turned out annually by the shoe section. Though the state factory, as a result of the uneconomic

methods of production, has always run at a loss, there seem to be good prospects for some expansion of both the tanning and leather goods industries, and the factory was therefore reorganised and re-equipped with modern machinery in 1953, and the output doubled.

Canvas and rubber shoes are now manufactured in Ceylon by the Bata Shoe Company, who opened a factory at Grandpass in Colombo in 1951. It produces 3,000 pairs a week, using high speed vulcanising equipment and mechanised operations throughout. Another factory, but Ceylonese-owned, was opened at Ratmalana the same year.

Other manufactures include safety matches, soap, rubber articles, cigarettes, confectionery and aerated waters at Colombo, furniture and cotton vests at Moratuwa, fertiliser at Kelaniya and Hunupitiya, chocolate at Welimada and Matale, beer at Nuwara Eliya and railway coaches at Ratmalana.

Hydro-Electric Power

Electricity is generated by the turning of a dynamo, and to make the dynamo turn, some mechanical power must be applied. For the generation of hydro-electricity, water-wheels, or turbines as they are called, are made to rotate by the force of a flow of water, and the turbine is connected to the dynamo and causes it to rotate. Power other than that of flowing or falling water, such as coal or oil, may also be used to generate electricity. In such a case we have carbo- or thermal-electricity. Apart from a few small hydro-electric plants on certain tea and rubber estates, there were only two hydro-electric plants in Ceylon installed for public use before 1950. These were at Nuwara Eliya and Norton Bridge. All other power supplies are thermal.

The exact potential of hydro-electric power in Ceylon has not yet been investigated with any degree of accuracy. A conservative estimate would not exceed 500,000 kilowatts.

The factors on which hydro-electric power depend are mainly (1) physical features, and (2) rainfall and associated river flow. In its descent from a mountain valley to sea level, a quantity of water produces an amount of energy which depends on the volume of the water and the distance of its fall. It is only practicable to utilise this energy, if nature concentrates a considerable part of the descent at a point, as in an actual waterfall. Even so, the actual head of water used is in part dependent upon some barrier constructed across the stream, the very possibility of which depends on the detailed topography of the site. In many cases it is more convenient to lead a part of the flow from the stream by a channel known as a *flume* to a point further downstream, where a considerable head is available. The water is then conducted to the turbines of the power station through pipes of large diameter known as *penstocks*, and then allowed to escape to its old channel.[1]

The actual lay-out of the plant will vary with every site, but in all there must be topographical possibilities of using a head of water. Other physical features include types of soil, presence of lakes and extent of forest cover.

Porous soils are very favourable for hydro-electric development, for they absorb rain water and therefore regulate the run-off, but unfortunately in Ceylon the rocks of the hill country are impermeable, and cause an excessive run-off during and immediately after rains. Forest cover increases the water storage capacity of the soil, for the leaf mass of the forest floor acts like a sponge ana makes for more even flow. So also do swamps and marshes, but lakes are best of all. In fact it is not practicable to develop hydro-electricity, unless the flow of water can be kept constant for long periods. And where natural storage is lacking as in Ceylon, reservoirs have to be constructed, and

[1] Head of water = vertical height of intake of penstock above turbine.

these add greatly to the cost and feasibility of hydro-electric schemes. Thus a modern hydro-electric station, with dam, flume, storage reservoir etc. calls for a much higher original cost than an equally modern thermal electric station. The thermal electric station, on the other hand, has a high operating cost on account of the price it has to pay for fuel, whereas the hydro station costs very little to operate.

In the dry zone 80% of the rainfall occurs in the four months, October-January, so that the rivers have a very long period of low water; but even in the wet zone there is a marked periodicity in the discharge of the rivers, two periods of low water in March and September separating two periods of high water in May-June and October-November. These wide fluctuations create problems of equalisation of the output of hydro-electric power. If the rainy season in the dry zone synchronized with the periods of low water in the wet zone, a system of inter-connection between different schemes would have made for a more regular and dependable supply of hydro-electricity. Maximum use of reservoir storage for regulation of flow must therefore be designed.

'No country can rely entirely on hydro stations for its electric power, unless it has a potential water power far in excess of its needs, or possesses rivers of extraordinarily steady flow. Ceylon is not provided with an excess of potential water power, and the flow of its rivers is very uneven. It is therefore not possible to meet all the Island's power needs from hydro-plants. Thermal plants will continue to be necessary to supplement the output of the hydro-plants, and ensure a steady total output of power at all times.'[1]

The sites of the potential water power sources of the Island listed by the Government Department of Electrical Undertakings are shown in Fig. 64.

[1] I.B.R.D. Report (1952) Part 2, pp. 229-30.

Of these perhaps the most important are:—

Aberdeen-Laksapana	150,000 kw.[1]
Victoria Falls-Rantembe	120,000 ,,
Kitulgala	37,500 ,,
Ulapane	30,000 ,,

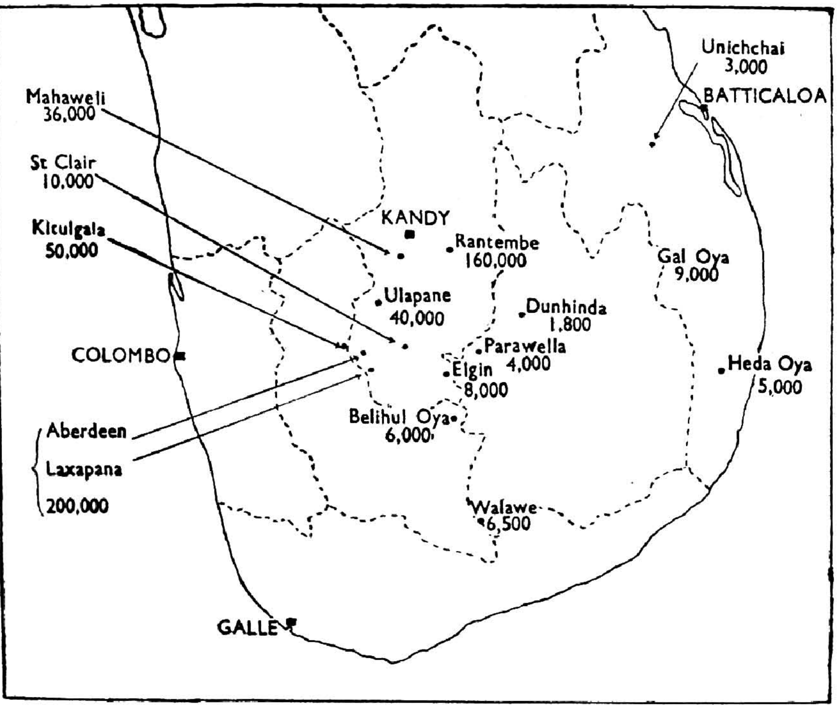


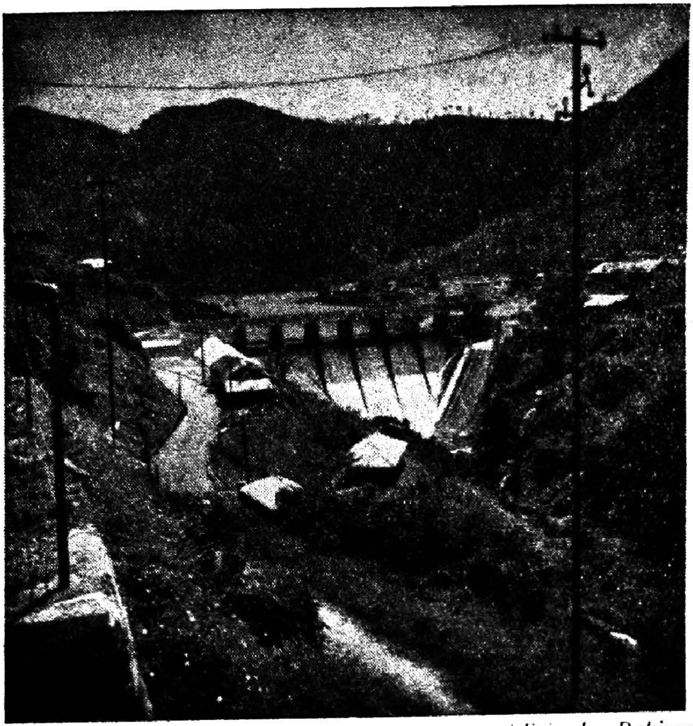
FIG. 64.—Estimated water power potential in h.p.

The schemes in the dry zone have a lower potential, but have been marked for early development as multi-purpose schemes, i.e. the power development is to be incidental to irrigation and flood control.

The Aberdeen-Laksapana scheme was planned to utilise

[1] kw. (kilowatt)=1,000 watts or 1.33 h.p. If an appliance with a loading of 1,000 watts is connected on to the mains for a period of one hour, it would consume exactly one unit of electricity. This is the unit paid for by consumers, and is known as a kilowatt hour (kwh.). 1 kw. of installed hydro-electricity effects a saving of 8 tons of coal per annum.

two tributaries of the upper Kelani, the Kehelgamu Oya, and the Maskeliya Oya, which flow past Norwood and Maskeliya respectively in parallel valleys separated by the



[*Eric L. Robinson*

FIG. 65.—The Kehelgamu Oya at Norton Bridge.

Bulathwalakanda ridge. The dam at Norton Bridge is 94 feet high, and bars the Kehelgamu Oya to form a narrow reservoir. From this reservoir a tunnel, $1\frac{3}{4}$ miles in length, takes the water through the Bulathwalakanda ridge to a surge chamber, and down through penstocks to the power house in the valley of the Maskeliya Oya, 1,500 feet below. For the first stage of the scheme, which was completed in 1951, two penstocks were laid, and three generators each of 8,333 kw. capacity installed at the power station.

Stage II, which involves the construction of another dam at Castlereagh, 4½ miles above Norton is now being pro-

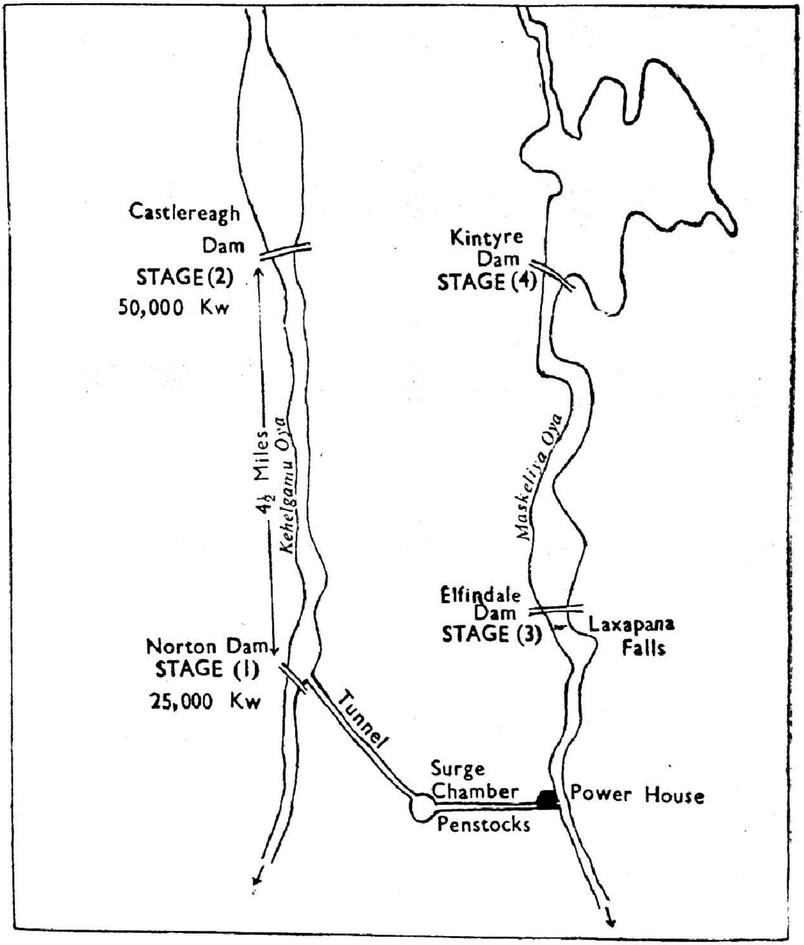


FIG. 66.—Sketch of Lay-out of the Aberdeen-Laksapana Scheme.

ceeded with, and will develop an additional 50,000 kw. It will consist of two parts:—

(a) The additional storage provided at Castlereagh will not only enable better regulation of the flow needed for Stage I, but will also develop another 25,000 kw. with new penstocks and generators installed alongside those of Stage I.

(*b*) The difference of level (about 500 feet) between Castlereagh and Norton will enable the water flowing from one reservoir to the other to provide additional power, by means of low-head generating plant of capacity 25,000 kw. installed at Norton Bridge.

Stages III and IV envisage the harnessing of the flow of the Maskeliya Oya above Laksapana Falls by dams at Elfindale and Kintyre to generate another 75,000 kw.

The Aberdeen-Laksapana source was selected as the first major source to be developed, as it possessed the following special features:—

1. An ultimate output of 150,000 kw. obtainable as a continuous 24-hour load.

2. Facilities for development economically in easy stages.

3. A central accessible situation in a healthy climate within reasonable distance of the most likely centres of power consumption.

4. A large catchment area with a heavy and well distributed rainfall:—

	Area, sq. miles	*Annual R'fall in Inches*
Aberdeen catchment	64	114
Laksapana "	61	134

5. Extensive storage areas with narrow outlets where reservoirs can be constructed at a relatively smaller cost.

6. A very high head—1,500 feet.

Prior to 1951 Colombo and its neighbourhood was supplied from the diesel and steam plants in the Government power stations at Kolonnawa and Pettah. With the inauguration of Stage I of the Laksapana Scheme, these plants were used as a standby, and also to supplement the Laksapana output during the dry season. Stage I of Laksapana now saves the country an outflow of Rs. 8,000,000 per annum previously spent on importing fuel oil.

The Nuwara Eliya plant uses a head of 250 feet at Blackpool, and has a total capacity of 330 kw.

The Gal Oya power house was completed in 1952, and a 33-kv transmission line from Inginiyagala to Amparai has just been laid.

EXERCISES

1. 'Ceylon can become entirely self-supporting in the matter of food and clothing.' How far do geographical conditions support this view?
2. Write a concise geographical account of the manufacture of salt in Ceylon.
3. What geographical factors favour the growth and survival of small scale industries in Ceylon?
4. How far do geographical conditions favour the development of hydro-electric power in Ceylon?
5. What do you understand by the 'tourist industry'? How far and with what success do you think it can be developed in Ceylon?

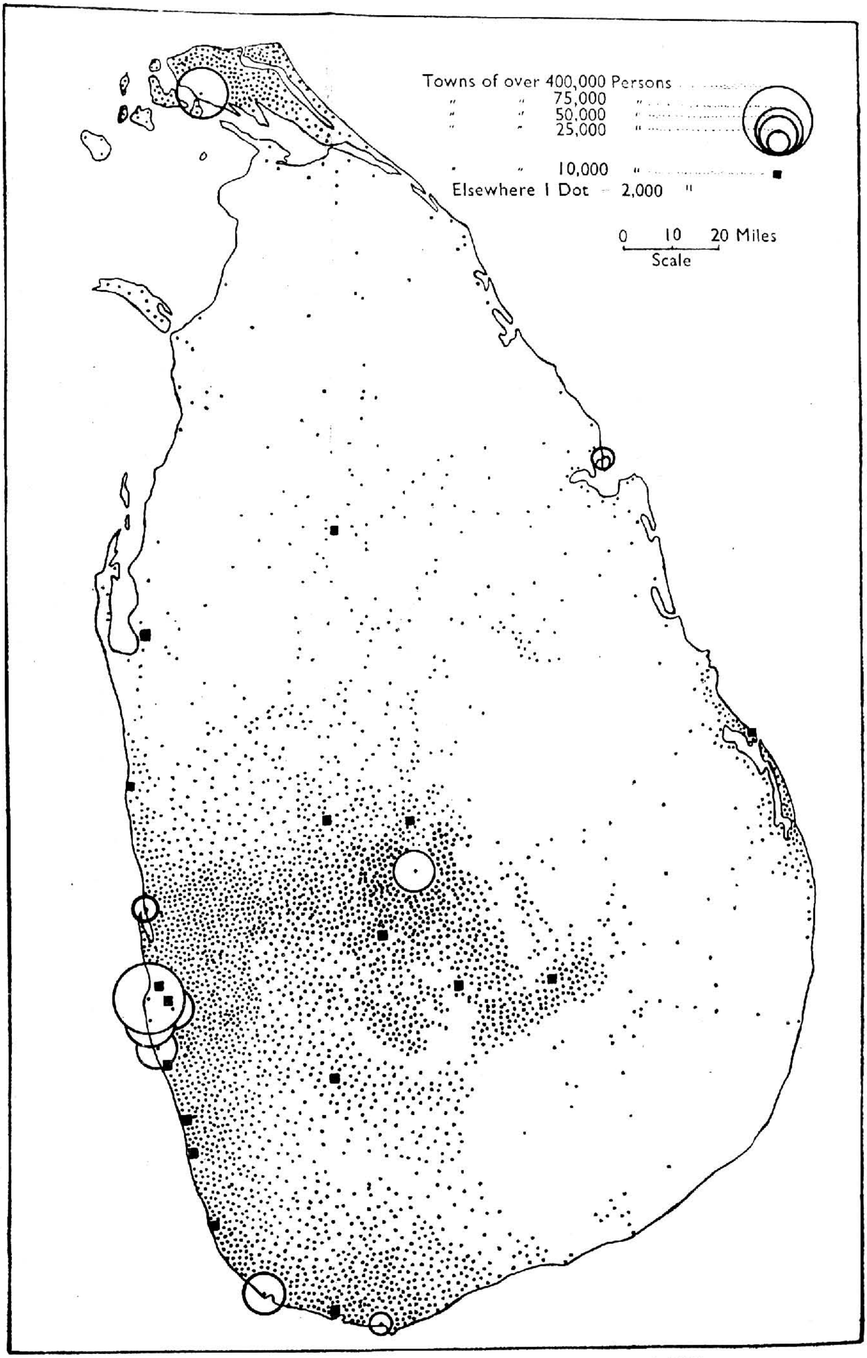


FIG. 67.—Ceylon: Population, Distribution at Census of 1953.

CHAPTER 16

POPULATION AND RACE

The total population of Ceylon numbered, 8,098,637 at the census of 1953, an increase of nearly 1½ million in seven years. The average density of the population thus works out to be 324 persons per square mile.

The racial composition of the population at the census was as follows:—

Low-Country Sinhalese	3,464,126
Kandyan ,,	2,157,206
Ceylon Tamils	908,705
Indians	983,304
Pakistanis	5,749
Ceylon Moors	468,146
Malays	28,736
Burghers	43,916
Other Ceylonese	20,678
Europeans	6,909
Other Foreigners	11,162

The accompanying map (Fig. 67) shows the distribution of population. The map shows that the population is rather unevenly spread. The main concentrations of settlement are (1) The lowlands of the south-west, (2) The plantation districts of the central hills, (3) The Jaffna Peninsula, and (4) The Batticaloa coastal strip. The regions of scantiest population are also four in number: (1) The Northern Province south of the Jaffna Peninsula, (2) The Anuradhapura and Trincomalee Districts except for the areas in the immediate vicinity of Anuradhapura, Trincomalee and Polonnaruwa, (3) The interior of the Batticaloa District, (4) South-eastern Uva and the adjoining Yala region. All

these are entirely in the dry zone. The dry zone was the most densely settled part in the heyday of Sinhalese civilisation. Not only was the dry season advantageous for the proper ripening and successful harvesting of their crops of paddy, but it also enabled them to clear the forest, as the need for bringing more land under cultivation increased. Indigenous agricultural development seems to have reached its zenith about the twelfth century. From that time onward, internal dissension and civil war, and invasions from South India led to the neglect and breakdown of the irrigation system. Perhaps also the appearance of malaria, or its increased virulence played some part in compelling the Sinhalese to abandon the dry zone for the fastnesses of the hill-country and the densely forested wet zone. Here grain was hard to raise, but the coconut palm grew luxuriantly, and supplied both food and shelter, while cinnamon obtained wild from the forest could be traded to the Europeans, who had established trading posts on the coast. The subsequent development of the wet zone is entirely due to its suitability for the successful growth of crops needed by the commercial nations of Europe and its comparative freedom from malaria. The European planters started with coffee, importing Indians to supply the manual labour, and when coffee failed, turned first to cinchona, and then to tea. In modern times rubber and coconut have also played their part in increasing the prosperity and population of the wet zone. It is now the region with the best developed network of communications, whither have gradually migrated many of the sons and daughters of the half-starved and malaria-stricken inhabitants of the dry zone. Now the region seems to be getting over-populated, and the government has started colonization schemes, such as those at Minneriya and Minipe, to reverse the movement.

The dense population of the Jaffna Peninsula is the

result of the interplay of both geographical and historical factors. Originally settled by fishermen and other colonists from the arid Carnatic plain of South India, the Peninsula, with its rainfall of over 50 inches, seemed a land of comparative plenty. The end-of-year rains were reliable enough for the successful growing of paddy, but right throughout the dry season, water could be obtained unfailingly from underground supplies, provided the effort was made to draw it out. Here were no surface streams, which by their partial drying up would provide breeding places for the malarial mosquito, nor was there a need for complicated irrigation systems, which could suffer damage or neglect during times of war or internal strife. The limited extent of cultivable soil also compelled the inhabitants to put each plot to the maximum possible use. The soil was by nature infertile, but yielded rich returns when skilfully manured. Thus the niggardliness of nature elicited hard work from the cultivator, and helped to nurture a hardy race, whose thrift and industry have become proverbial.

On the east coast there is a certain amount of settlement on the land bordering the lagoons, whose inhabitants draw their sustenance from the cultivation of paddy and coconut eked out by a little fishing.

Population by Provinces and Districts According to Censuses of 1946 and 1953

	District	Area sq. mls.	1946		1953	
W.P.	Colombo ...	808	1,420,332	1,876,904	1,707,872	2,231,820
	Kalutara ...	623¾	456,572		523,948	
C.P.	Kandy ...	913¾	711,449	1,135,290	840,448	1,366,596
	Matale ...	902½	155,720		201,126	
	Nuwara Eliya	473¾	268,121		325,022	
S.P.	Galle ...	652¼	459,785	961,418	524,382	1,130,014
	Matara ...	481¼	351,947		413,904	
	Hambantota ...	1,012¾	149,686		191,728	
E.P.	Batticaloa ...	2,792	203,186	279,112	270,722	355,231
	Trincomalee ...	1,048	75,926		84,509	

	District	Area sq. mls.	1946		1953	
N.P.	Vavuniya ...	1,466½	23,246	479,572	35,119	571,214
	Jaffna ...	998½	424,788		492,384	
	Mannar ...	964¼	31,538		43,711	
N.W.P.	Puttalam ...	909¾	43,083	667,889	58,878	854,915
	Chilaw ...	262½	139,764		169,963	
	Kurunegala ...	1,843¾	485,042		626,074	
N.C.P.	Anuradhapura	4,008½	139,534	139,534	229,174	229,174
Uva	Badulla ...	3,277¾	372,238	372,238	468,835	468,835
Sab.	Ratnapura ...	1,250½	343,620	745,382	420,317	890,838
	Kegalla ...	642	401,762		470,521	

The following were the largest towns in Ceylon at the census of 1953:—

Colombo—Municipality ...	423,481
Dehiwala—Mt. Lavinia—U.C. ...	80,086
Jaffna—Municipality ...	77,218
Moratuwa—U.C. ...	58,160
Kandy—Municipality ...	57,359
Galle—Municipality ...	55,874
Kotte—U.C. ...	53,862
Negombo—Municipality ...	38,591
Trincomalee—U.C. ...	28,236
Matara—U.C. ...	27,697
Kolonnawa—U.C. ...	21,385
Panadura—U.C. ...	20,380
Kalutara—U.C. ...	20,354
Anuradhapura—U.C. ...	18,431
Kurunegala Municipality ...	17,319
Badulla—U.C. ...	17,294
Batticaloa—U.C. ...	17,273
Matale—U.C. ...	17,265
Wattala—U.C. ...	16,044
Ratnapura—U.C. ...	16,002
Weligama—U.C. ...	12,799
Nuwara Eliya—Municipality ...	12,788
Beruwala—U.C. ...	12,502
Chilaw—U.C. ...	11,274
Gampola—U.C. ...	10,811
Ambalangoda—U.C. ...	10,554
Puttalam—U.C. ...	10,268
Nawalapitiya—U.C. ...	9,740
Gampaha—U.C. ...	7,526
Tangalla—U.C. ...	6,840
Hatton-Dikoya—U.C. ...	6,383
Kegalla—U.C. ...	5,533

Races.—A race is a group of people possessing certain physical and mental characteristics, generally attributable to a common ancestry, and sometimes modified by environment. According to the anthropologists, the more distinctive physical indications of race are texture of hair, shape of skull, stature of body, and eye colour, but to the layman colour of skin, habits and language seem just as important, and there is a tendency to confuse language with race.

The division of Sinhalese into Low-Country and Kandyan, first made in the census of 1901, has no real ethnic basis, but environment and the events of history of

the last four centuries have caused some slight differentiation. Secure in their mountain fastnesses, the Kandyans maintained their independence for a longer time, and had much less contact with the outside world. Isolation has made them more conservative, and they have retained their own customs, dress, and even legal system. The low-country Sinhalese, on the other hand, as a result of exposure to foreign influence and closer contact with European civilisation, have been more adaptable and progressive. It is they who contributed mainly to the growth of the Sinhalese middle class, from whose ranks arose the principal agitators for political reform and independence. The Sinhalese trace their origin to Vijaya and his band of followers from North India, who, according to tradition, reached Ceylon in 543 B.C., and subjugated the original inhabitants. These aborigines, the Veddahs, were a mixture of three racial types, Negrito, Australoid and Mediterranean. Though the newcomers drove the aborigines to the less favoured interior, their separation was not quite complete. From time to time they mingled and intermarried, giving rise to the Sinhalese people of today. The Sinhalese are predominantly Buddhist by religion.

The Ceylon Tamils are descendants of early settlers who reached the Island from South India, and settled mainly in the northern and eastern parts of the Island. The Jaffna Tamils are an industrious and frugal race, owing their capacity for hard work to the stern conditions imposed on them by mother nature in their ancestral lands. These characteristics they retain, even when they move out to other parts of the Island, and are thus able to compete successfully with the other races. The 'koviyas' of Jaffna are supposed to be of Sinhalese origin. The persistence to this day of Sinhalese names in the Peninsula, e.g. Kodikaman (Kodigama), Vaddukoddai (Wadugoda), Chunnakam (Hunugama) etc. is evidence that these parts were

under Sinhalese occupation in the past,[1] but invasion of the region in force by Tamils from South India resulted in its subjugation. The Sinhalese who survived and yielded were proselytized and assimilated by their conquerors, who assigned them to a lower place in society, e.g. that of 'koviyas' (goviyas).[2]

The Indian Tamils, who even outnumber their namesakes in Ceylon, are an entirely modern introduction, imported to provide hired labour on the estates, to which the Sinhalese peasant, who had hitherto tilled his own land, was averse. They are most numerous in the Nuwara Eliya, Kandy and Badulla Districts, and in the Nuwara Eliya District form the majority of the population. Apart from estate work, many Indian Tamils are employed as unskilled labourers on roads, railways and other public works. In recent years the pressure of the native population on the land has set in motion a movement to repatriate all Indians who cannot make out a claim for admittance to Ceylon citizenship. The Tamils of both Ceylon and India are predominantly Hindu by religion.

The Ceylon Moors are descendants of Arab traders, whose settlements on the coast date probably from the 8th century. They have now spread to every part of the Island, but are most numerous in the Batticaloa District, and also form a high percentage of the population of the Puttalam, Mannar and Trincomalee Districts. In two towns, Puttalam and Beruwala, they form the majority of the population.

The Malays, who trace their origin to Java and the Malay Archipelago, are of Mongoloid stock, but having intermarried with the local inhabitants, are tending to lose their Mongoloid features. Both Moors and Malays are

[1] See Chulawansa, Part I (Geiger) page 295, ch. 70, vv. 90-92.
[2] See Ancient Jaffna by Mudaliyar C. Rasanayagam, page 383.

Mohammedan by religion, but the latter are less conservative, and not so ostentatious of their faith.

The Burghers are the descendants of Dutch settlers and other European employees of the Dutch East India Company, who were allowed to continue in Ceylon after the British conquest. For several generations they formed a middle class between the indigenous population and their English rulers, supplying most of the Island's doctors, lawyers, teachers and clerks, but with the grant of independence are tending to lose their identity. Like their forbears they are predominantly urban. Included with them in the census returns, are a smaller number of Eurasians (about 3,000), who are the offspring of European and Sinhalese or Tamil parents.

The Europeans, who are mainly British, are temporary residents, merely building up their finances, till the time comes for them to go home to Britain, or perhaps find a new home down under or in South Africa. The majority are planters, but a good number are Christian missionaries or business men, assistants in commercial houses or government employees. The last group is now fast decreasing. More than half the Europeans are in the Colombo District, the city alone having about 45% of the total European population of the Island. Other Districts with more than 250 Europeans within their limits are Kandy, Nuwara Eliya and Badulla.

EXERCISES

1. Describe and account for the distribution of population and races in Ceylon.

2. What geographical conditions have promoted a great density of population in the south-western lowlands as compared with the Rakwana Hills?

CHAPTER 17

COMMUNICATIONS

In comparison with tropical countries, Ceylon is well provided with roads, having about 14,000 miles of motorable roads. Over 5,000 miles of these are metalled, tarred and well surfaced. The excellence of the roads is due to the abundance of road metal provided by the crystalline rocks, outcrops of which occur in most parts of the Island except Jaffna.

The modern roads of Ceylon date only from British times. Before the nineteenth century, Colombo and the towns of the south-west coast were connected by sandy roads constructed by the Dutch. These were wide enough to permit of processions on foot and animal back, but hardly suitable for wheeled transport. In the hill-country, on the other hand, the existing roads were only bridle tracks just enough for one man to pass. Goods were transported by coolies or bullocks—the latter as pack rather than draught animals. An interesting relic of this form of transport still survives in the region of S. Martin's Estate, Rangala, along the footpath running over the Knuckles ridge through Corbett's Gap.

Fig. 68 shows the main trunk roads that radiate from Colombo to all parts of the Island. A network of minor roads affords frequent connection between these trunk roads in the more developed western and southern parts of the Island, but in the north and east such inter-connections are few and far between.

The roads are generally on the narrow side, the only broad highway being the Colombo-Moratuwa section of the Galle Road. Several sections of these low-country roads are liable to interruption by floods. In hilly country the roads are also extremely curved. Prior to the Second World War the road system in the wet zone was adequate to the demands made on it, but the spread of omnibus services and the phenomenal increase of motor traffic in

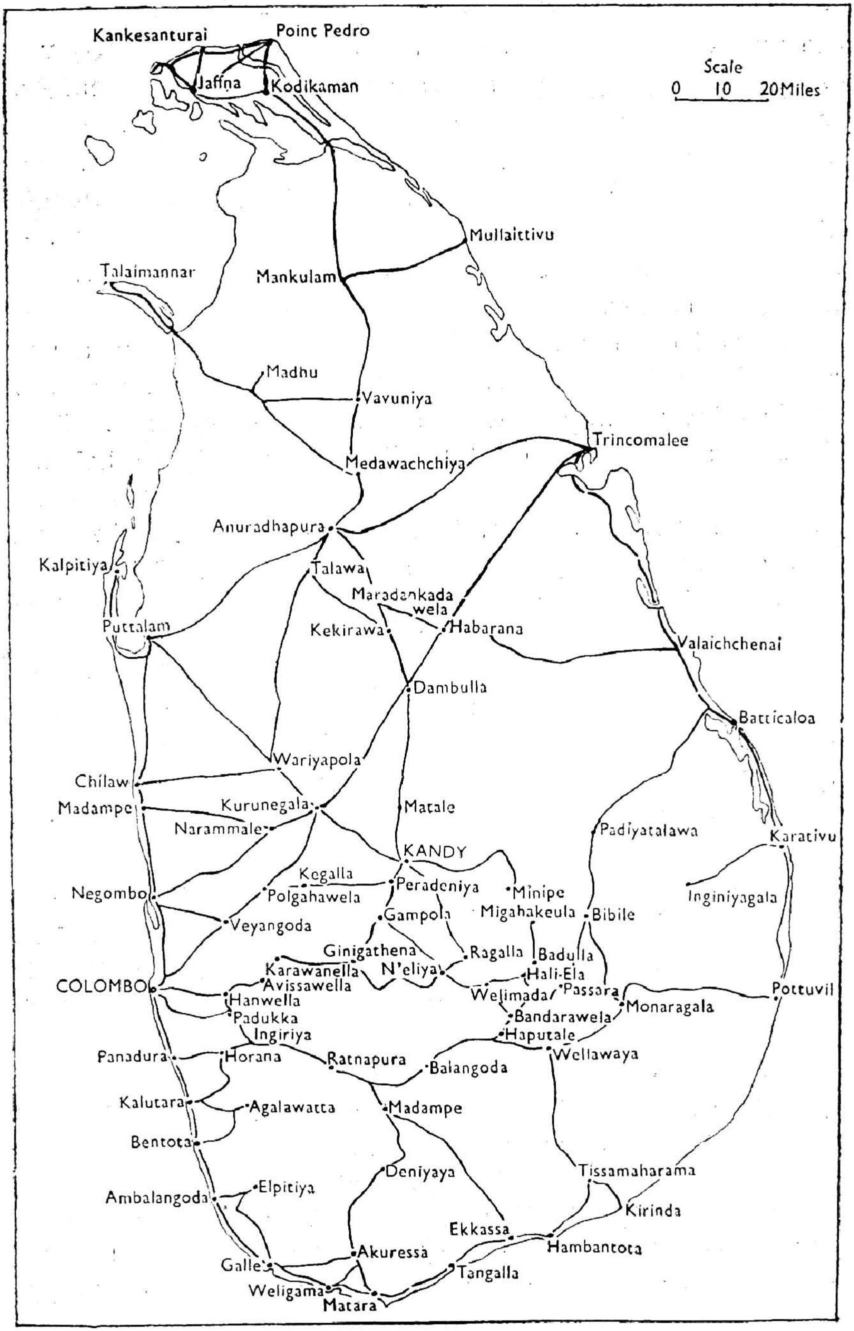


FIG. 68.—Ceylon: Main Trunk Roads.

the post-war period have caused serious congestion, particularly in urban areas and at bridges. A programme of road widening and bridge construction is in progress, but is not able to keep pace with the demand. Modern construction plant and equipment are not adequately availed of, and there is a severe shortage of engineering and technical skills, and too much dependence on overseers and unskilled labour.

Apart from the trunk roads shown on the map, a new road is being constructed linking Alutnuwara and Padiyatalawa, which will shorten the distance from Batticaloa to Kandy by 60 miles. The distance between Kandy and Badulla will be shortened by the new Lower Badulla Road. Motor omnibuses ply on all the main roads of the Island. They provide a cheap means of transport, but suffer from many defects, of which over-crowding, long waits and break-downs are the chief.

Railways.—The railways are all state-owned. The total railway mileage is 896 miles, of which 809 are broad gauge (5½ feet), and 87 narrow gauge (2½ feet). Both these radiate from Colombo. They played an important part in the opening up of the Island, and until about 1930 brought a handsome profit. Since then, competition from road transport has made the railways a financial liability, and except during the war years, 1941-6, they have run at a loss. A new Motor Traffic Act was brought into operation in September 1951, to control and regulate road transport, to reserve long-haul traffic as far as possible to the railway, and to secure the co-ordination of road and rail transport.

The Main Line, which was the first to be constructed, runs north-east through Polgahawela *via* the Kadugannawa Pass to Peradeniya and Kandy. Later the line was extended from Peradeniya to Nawalapitiya, Nanu-Oya (for Nuwara Eliya) and Bandarawela, and now terminates at Badulla. The Kandy Line now terminates at Matale. At Polgahawela

the Northern Line branches off. It runs through Kurunegala, Anuradhapura and Jaffna and terminates at Kankesanturai. From this line there are branches, at Maho to Trincomalee and Batticaloa, and at Madawachchiya to Talaimannar for India. The former forks at Galoya in the Polonnaruwa District. A coastal railway runs southwards from Colombo to Galle and Matara, while another ran northwards to Puttalam, but now terminates at Bangadeniya, a few miles north of Chilaw. The only narrow gauge line runs eastwards from Colombo along the Kelani valley to Avissawella, and then south-eastwards to Ratnapura and Opanaike. A branch line to Yatiyantota from Avissawella, as well as the narrow gauge line from Nanu-Oya through Nuwara Eliya to Ragalla, has since been scrapped. The narrow gauge lines are extremely curved, and therefore slow and jerky to travel along, the 85-mile run to Opanaike taking over eight hours, so that the question of discontinuing the operation of this line too is under consideration.

Canals.—A series of canals, a legacy of Dutch times, connect the lagoons of the west coast and provide a continuous waterway of some 120 miles, navigable by padda boats linking Puttalam in the north with Kalutara in the south. These canals provide the cheapest means of transport when time is of no consequence, for produce like paddy, salt and coconuts entering into local trade. There are also about 45 miles of boat channel maintained by dredging the Jaffna Lagoon.

Aerial Transport.—Civil aviation expanded greatly as a result of the war. The military airport at Katunayake was built to receive the heaviest aircraft, Ratmalana airport underwent several improvements, and aerodromes were constructed in various parts of the country, as at Puttalam, Palaly, Minneriya, Trincomalee and Vavuniya. With the coming of peace, the Department of Civil Aviation, previously under the control of the Department of Public

Works, was given an independent status, and Ceylon was admitted to membership of the International Civil Aviation Organisation, thus enabling it to conclude bilateral arrangements with other countries to operate services through those countries, and pick up and set down passengers, mails and freight. The Government next started an airline known as Air Ceylon, which set out to develop scheduled services to other countries rather than local operations. With the conversion of Air Ceylon to a public corporation in 1951, this policy has given way to that of concentrating on local services, and encouraging the use of Colombo as an international nodal point for foreign airlines, by providing it with all the facilities that are available in all international air ports of the highest class. The Ceylon Air Academy was established to provide flying training for Ceylonese and popularise internal air travel. There are at present three airports in Ceylon.

The Colombo Airport of Ratmalana is only four miles from the southern end of the town, and is being gradually improved and extended to meet the highest international standards. Previously, heavier aircraft had to use the R.A.F. airport at Katunayake. This had the disadvantage of being nineteen miles distant from Colombo, and is now used by civil aircraft only as a standby.

The Jaffna Airport at Palaly is about twelve miles north of Jaffna, and first became important as a stop for Air Ceylon services to Madras and Trichinopoly, but is increasing in importance as an internal air link between Colombo and Jaffna. The aerodromes at Puttalam, Minneriya, Trincomalee and Vavuniya are being maintained as emergency landing grounds, and another has recently been constructed at Amparai to serve the Galoya Development Board.

Air services.—Air Ceylon Ltd. operates a daily service from Colombo to Jaffna with extensions to Madras and Trichinopoly. A daily service from Colombo to Minneriya

and Trincomalee was commenced in February 1955. International services operated by Air Ceylon were closed down in 1953, as they were being run at a loss. Other international airlines operating through Colombo are British Overseas Airways Corporation (B.O.A.C.), Royal Dutch Airlines (K.L.M.), Trans-World Airlines (T.W.A.) and Qantas Airways. BOAC in association with Qantas has four services a week connecting London and Colombo with extensions to Singapore, Sydney and Tokyo. TWA have a twice-weekly service linking New York and Colombo, one *via* Bombay, Cairo and Paris, and the other *via* Madrid, Lisbon and Azores. KLM provide a weekly link between Amsterdam and Tokyo *via* Colombo and Bangkok. Air India operates a daily service linking Colombo and Bombay *via* Madras.

Ports and Shipping.—Apart from Colombo, which ranks as one of the world's largest ports, there are a number of minor ports at intervals along the coast. Of these, two have natural harbours, Galle and Trincomalee, but the others are mere roadsteads, as at Batticaloa and the northern ports of Kayts, Kankesanturai, Valvettiturai, Point Pedro and Jaffna.

Colombo, as a result of its geographical position on the world's shipping routes to the Far East and Australia, has a far greater tonnage of vessels entering its harbour than any other eastern port such as Bombay or Singapore. Since 1947 the traffic has increased to such an extent, as to cause serious port congestion and slower ship turn-round. The chief deficiency was lack of alongside deep-water berths, so that boats and lighters had to be used, and no direct embarkation or disembarkation of passengers or goods was possible. Accessibility to the port area by road, rail and canal is inadequate, the continued use of bullock carts slows down traffic, and there is an insufficiency of transit-shed and warehouse accommodation.

The harbour encloses an area of some 640 acres and can admit vessels drawing up to 36 feet. Berth accommodation is available for about 37 large vessels and 5 small vessels. A broad gauge railway runs through the premises of the port, and is connected with the main railway system. The Beira Lake is an integral part of the port, to which it is connected by canal. The canal is navigable by 40-ton barges carrying full loads, and relieves the congestion not only on the roads, but also in the harbour, by affording mooring and reception facilities for the barges.

A big scheme for the modernisation of the port of Colombo by providing seventeen alongside berths with all quay amenities for the quicker turn round of shipping was put in hand in 1950. The Port Development Scheme will develop the port in four stages. Stages I and II include the construction of seven alongside berths for cargo-vessels and an oil dock for the discharge of tankers. Stage III will include another six berths for passenger liners and ships taking in oil bunkers. Stage IV will extend the existing breakwater to give an outer harbour of 450 acres and increase the alongside berths to seventeen, and also provide additional exchange berths.

Galle.—The harbour of Galle is formed by a bay between the headland of Galle Fort on the west and the promontory, known as Watering Point on the east. The bay faces south, and therefore has no protection from the south-west monsoon, but only from the north-east monsoon. There are also many rocks and shoals both at the entrance and

PLATE 2.
Colombo Harbour

On the left is the Queen Elizabeth Quay almost completed; in the centre, opposite the present Passenger Jetty, the Delft Pier is in process of construction; while in the background is the Mutwal Quay. In front of the latter is seen the North Pier of the oil dock.

[*C. P. Koch*

within the bay that make entry rather dangerous. It is the expense of removing these, that has hindered the development of Galle as a port. However, because of the increasing congestion in Colombo in recent years, the Government has decided to effect some improvements, and construct a quay and a fumigatorium to enable rice and food imports needed for the southern parts of the Island to be diverted to Galle. This is in line with the recommendations of the World Bank Mission that partial improvements should be effected, not haphazardly, but as part of a master plan for the ultimate full development of the port. The first step in this connection was the deepening of berths in February 1955, to permit of the entry of ships drawing up to 30 feet.

Trincomalee.—In spite of its great natural advantages and the capaciousness of its harbour, Trincomalee has not been much developed as a commercial port. Fort Ostenburg is outside the U.C. limits and is under the control of the British Admiralty. If alongside quays and commercial facilities are to be developed, they should be well away from the naval establishments, and at a point where road and rail communications are easy to provide, where there is a sufficient area and depth of water close to the shore, and also ample land room for future expansion. The narrow isthmus on which the town stands at present lacks many of these facilities, and the World Bank Mission has suggested Cod Bay as a suitable site for a future port.

EXERCISES

1. What part has topography played in determining the pattern of communications in the Hill-country?
2. Examine the claims of Galle, Trincomalee and Kankesanturai for development as commercial ports.

CHAPTER 18

TRADE

As Ceylon is predominantly an agricultural country, her income is obtained primarily from agricultural commodities produced either for export or for home consumption, the latter in Ceylon playing only a minor role. In recent years the income derived from exports has amounted to over one-third of the national income. And of these exports, tea, rubber and coconuts form more than 90%. Our prosperity therefore depends on the prices fetched by these products in the world's markets. Unfortunately for us, these prices depend on conditions entirely outside our control, and we can do little to alter them. Our exports provide only a very small part of the world supply, and our imports only an infinitesimal part of the world demand.

The nature and value of Ceylon's trade is given in the annual administration reports on Customs and Shipping, which the student should consult for details. The value of Ceylon's trade in recent years is shown in the following table in millions of Rupees:—

Year.	Imports.	Domestic Exports.	Re-Exports.	Total Exports.	Visible Balance of Trade.
1938 ...	236	265	20	285	+ 49
1948 ...	994	940	71	1,011	+ 17
1949 ...	1,029	1,008	55	1,063	+ 34
1950 ...	1,167	1,498	65	1,563	+ 396
1951 ...	1,559	1,823	78	1,901	+ 342
1952 ...	1,702	1,408	90	1,498	− 204
1953 ...	1,608	1,485	78	1,563	− 45

We see from the above table that there was a progressive expansion in post-war trade till 1951, when the total value of Ceylon's trade amounted to Rs. 3,460,000,000. with a favourable balance of trade of Rs. 342,000,000. The unprecedented rise in the value of exports was due to the

enhanced prices obtained by our exports of rubber, following the outbreak of the Korean War in June 1950. This rubber boom was followed by a slump after the Korean cease-fire, and there was a sharp decline in price in 1952, which was only arrested by the conclusion of the trade pact with China in October, 1952. 1952 also saw a decline in prices of tea, coconut and other exports, and this, coupled with the rise in prices of our imports, particularly of rice, resulted in a trade deficit of over Rs. 200,000,000. Towards the end of 1952 export prices began to improve, while a fall took place in the prices of imported rice and sugar, thus helping to diminish considerably the trade deficit to Rs. 45,000,000.

Figs. 69 and 70 illustrate the nature and direction of Ceylon's foreign trade.

Exports.—In 1953, one-quarter of the total exports by value went to the United Kingdom, one quarter to other countries of the British Commonwealth, one-sixth to China, one-twelfth to U.S.A., and the remainder to other foreign countries. After China, Australia was our best customer, followed by U.S.A., Canada, South Africa, Holland, Egypt and India.

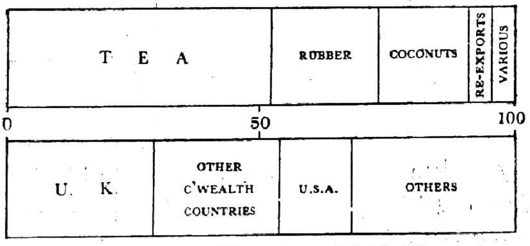


FIG. 69.—Exports, 1948-52.

Tea, rubber and coconuts accounted for 96% of the value of our domestic exports in 1953, tea contributing as much as 55%. Exports of tea went principally to U.K. (34%), Australia (14%), U.S.A. (10%), and in smaller quantities to other Commonwealth countries. Rubber exports amounted to 22% of the value of our exports and went mainly to China (60%), U.K. (14%), and U.S.A. (8%).

Since the conclusion of the Trade Pact with China, the pattern of our rubber exports has completely changed, and there has been a switch-over from crepe rubber to sheet rubber production on the estates. In the period 1948-50, U.S.A. purchased most of our rubber, taking as much as 40%, while the U.K. took about 18%. Coconut exports amounted to 18% of our total exports. Coconut oil went mainly to Holland, Italy and Canada, copra to India and Pakistan, while the U.K. was the principal purchaser of our desiccated coconut, fresh nuts and fibre.

Imports.—In 1953, nearly 50% of our imports consisted of foodstuffs, of which rice and wheat flour were the chief, while manufactures, of which cotton textiles and machinery were the chief, constituted 40%, while the remaining 10% was of raw materials, of which the chief were crude oil and coal. Over one-fifth of our total imports by value came from the United Kingdom, over one-eighth from China, one-eighth from India, over one-tenth from Australia, one-twelfth from Burma, and the remainder from other foreign countries, of which Japan, U.S.A. and Holland were the chief. The U.K. sent mainly manufactured goods, of which the chief were motor vehicles and spares, machinery, cement, and cotton and woollen goods; China sent mainly rice and foodstuffs and some silk manufactures; India, cotton piece-goods, foodstuffs (dry-fish, chillies and onions) and coal; Australia, wheat flour, milk-foods, butter, fruits and other foodstuffs; while Burma sent rice and teak. Of the other foreign countries, Japan sent mainly cotton textiles and miscel-

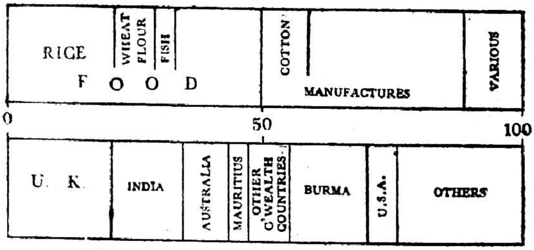


FIG. 70.—Imports, 1948-52.

laneous manufactures, U.S.A. sent mainly wheat flour, tobacco, motor vehicles including tractors and other agricultural machinery, patent medicines, lubricating oil, kerosene and petrol; and Holland, wheat flour, condensed milk and potatoes.

The following is a tabular summary of the export and import trade of Ceylon for 1953. The student should bring this up to date by consulting the latest Annual Administration Report on Customs and Shipping.

EXPORTS

	Value in million Rs.	Importing Countries and percentage of total value for 1953 taken by each
Tea	825.0	U.K. 34; Australia 14; U.S.A. 10.
Rubber	337.6	China 67 ; U.K. 11.
Coconuts	2.7	U.K. 56 ; Germany 20; Italy 10.
,, Desiccated ...	78.8	U.K. 46 ; Germany 15.
,, Oil	142.1	Holland 27; Italy 18; Canada 15.
Copra	22.9	India 86; Pakistan 10.
Coconut Fibre ...	23.6	U. K. 40; Australia 14; Japan 11.
,, Yarn ...	2.1	Ger. 28; S. Africa 18; Den. 15.
, Poonac ...	.9	Belgium 99.
Cocoa	9.7	Philippines 39; U.K. 11; Holl. 10.
Cinnamon	7.4	Mexico 38, U.S.A. 18.
,, Oil	.5	U.K 29; India 11.
Papain	7.1	U.S.A. 79.
Citronella Oil	2.8	U.K. 22 ; U.S.A. 19; India 11.
Pepper	2 2	U.S.A. 93.
Arecanuts	3.7	India 95.
Tobacco	1.3	India 99.

IMPORTS

Class I Food, Drink and Tobacco	Value in million Rs.	Chief Sources.
Rice	323.5	China, Burma.
Wheat flour	163.6	Australia, Holland, U.S.A.
Sugar refined	66.1	Mauritius, Br. W. Indies, Australia.
,, unrefined... ...	5 2	India, Thailand, Indonesia.
Milk and milk foods ...	30.9	Australia, Holland, Canada, U.S.A.
Dried fish	47.9	India, Pakistan, S.W. Asia.
Maldive fish	3.7	Maldives, Japan.
Tinned fish	5.8	South Africa, U.K.
Dried chillies	19.3	India, Thailand.

IMPORTS—(*continued*)

Class I Food, Drink and Tobacco	Value in million. Rs.	Chief Sources.
Other curry stuffs ...	9.8	India, Morocco, China, Japan.
Potatoes	14.2	Holland, Cyprus, Italy.
Onions	11.1	India, Egypt, Syria.
Butter	4.8	Australia.
Eggs	3.8	India.
Sheep and Goats ...	3.6	India.
Frozen meat	2.3	Australia.
Coffee	2.7	Uganda, Indonesia.
Tobacco manufactured including beedies and cigars ...	8.6	India.
Tobacco Raw	6.4	U.S.A., India.
Cigarettes	.3	U.K.

Class II Raw Materials.		
Fuel oil	75.2	Iraq, Singapore, Bahrein.
Coal	25.3	India.
Fertilisers	38.4	U.K., France, India.

Class III Manufd. Goods		
Cotton goods	108.0	India, U.K., Japan.
Artificial silk and silk ...	40.5	Japan, India, U.K.
Apparel excl. footwear ...	11.1	Hongkong, U.K., Japan, India.
Leather footwear ...	3.3	India, U.K.
Woollen and worsted manufs.	3.1	U.K., India.
Machinery	68.3	U.K., U.S.A.
Iron and Steel	54.8	U.K., France.
Electrical goods ...	24.4	U.K., Singapore.
Motor vehicles and tractors	44.5	U.K., U.S.A.
Motor accessories ...	13.9	U.K., U.S.A.
Petrol	26.6	Bahrein, Italy, Arabia.
Tyres and tubes ...	13.5	U.K., India.
Kerosene	11.8	U.K., Arabia, U.S.A.
Chemicals	17.9	U.K., U.S.A.
Cement	16.5	U.K., Japan.
Patent medicines ...	9.7	U.K., U.S.A.
Paper	9.5	U.K., Sweden, Norway.
Cinema films	3.7	India, U.S.A.

EXERCISES

1. Examine the main features of the present overseas trade of Ceylon.

2. Describe the functions of Colombo as an entrepôt port. Compare with other entrepôt ports in Southern Asia.

3. Show by means of a pie-graph (i.e. a circle divided into sectors indicating percentage value), the respective parts played by Ceylon's main exports in 1953, using the data given on pages 187-8. Show only four categories, viz. tea, rubber, coconut products, other exports.

CHAPTER 19

NATURAL REGIONS

In the preceding chapters we have considered certain special aspects of the geography of Ceylon, such as land forms, climate, vegetation—aspects which geologists, physicists and botanists may claim as branches of their special sciences. But while these scientists study these branches as independent phenomena appropriate to their respective sciences, the geographer considers them, not as independent phenomena, but in their relations and interactions with each other and with man. To a certain extent the combination of environmental conditions determines the activity of man, but not entirely, for man is able by his skill to modify or triumph over his environment. Thus the early Sinhalese were able to colonise and develop only the dry zone; the development of the wet zone had to await the introduction of a higher degree of technical skill by peoples from Europe. Nevertheless, particular combinations of environmental conditions contrive to give a particular distinctiveness and character to a particular region, and on this basis we may divide any country into its constituent natural regions. A natural region is therefore one that is marked out from adjoining areas by a combination of natural conditions.

Structural regions, climatic regions and vegetation regions are all, in a sense, natural regions, but when some specific set of criteria such as those pertaining to structure, climate or vegetation alone are used to divide a country into regions, it is customary to refer to such regions by terms denoting the basis of the division. They are thus

specifically referred to as structural, climatic or vegetational regions. But when a combination of criteria are employed, the term 'natural region' or 'geographical region' is preferred. Some writers would restrict the term 'geographical region' to regions which are demarcated not merely by a combination of physical factors, but when the human factor, or influence of man, is also included with these. It is the study of geographical regions which is the essence of geography. The geologist would divide the earth into structural regions, the climatologist and meteorologist would demarcate climatic regions, and the botanist regions of natural vegetation. Each of these specialists is, however, concerned only with his own specialism, and not with its relation to other specialisms and to man. It is the special duty of the geographer to bridge the gap between the study of the natural sciences and that of humanity, to study regions as entities and examine their constitution, functioning and external relationships. Each of his regions would have an individuality of its own, the distinctiveness of which would depend on the number of natural conditions that combine to give it this individuality. This individuality is most recognizable in the central-most parts of the region, but towards its borders it may merge rather imperceptibly into that of an adjoining region. The borders are often a debatable land with transitional characteristics. The boundaries of geographical regions are therefore, more often than not, only approximations, and there is not likely to be complete agreement, as to exactly where the boundary is to be drawn. However, the drawing of a precise boundary is of far less importance than the study of the content of the region.

The broadest division of Ceylon would be into 'low-country' and 'up-country'. The low-country may also be broadly subdivided into Wet Zone and Dry Zone. These

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three broad divisions may be further subdivided (see Fig. 71) as follows:—

Low-country, Wet Zone:
(1) The South-west lowlands.
(2) The Sabaragamuwa scarplands.

Low-country, Dry Zone:
(3) The N.-W. coastal plain (Arid Zone).
(4) The Jaffna Peninsula and Islands.
(5) The Eastern coastal plain.
(6) The North-central Tank Country.
(7) The Eastern and South-eastern foothills.
(8) The South-east lowlands.

Up-country:
(9) The Uva Basin.
(10) The Hatton Plateau.
(11) The Pidurutalagala Ridges and High Plains.
(12) The Adam's Peak Ranges and Southern Mountain Wall.
(13) The Madulsima Ridge.
(14) The Kandy Plateau.
(15) The Balangoda and Koslanda Plateaus and the Deniyaya-Rakwana Massif.
(16) The Knuckles Hills.

THE REGIONS OF THE WET ZONE

The South-West Lowlands may be said to extend inland up to about the 500-foot contour. In the latitudes of Negombo, Colombo and Kalutara, the eastern limit may roughly be placed along the provincial boundary, but north of the Maha Oya the plain widens almost up to Kurunegala, while in the south it is considerably narrower. The hard crystalline rocks of which this region is composed are largely buried under a thick mantle of cabook and lateritic soils, which, in the flood plains of the rivers, are in turn

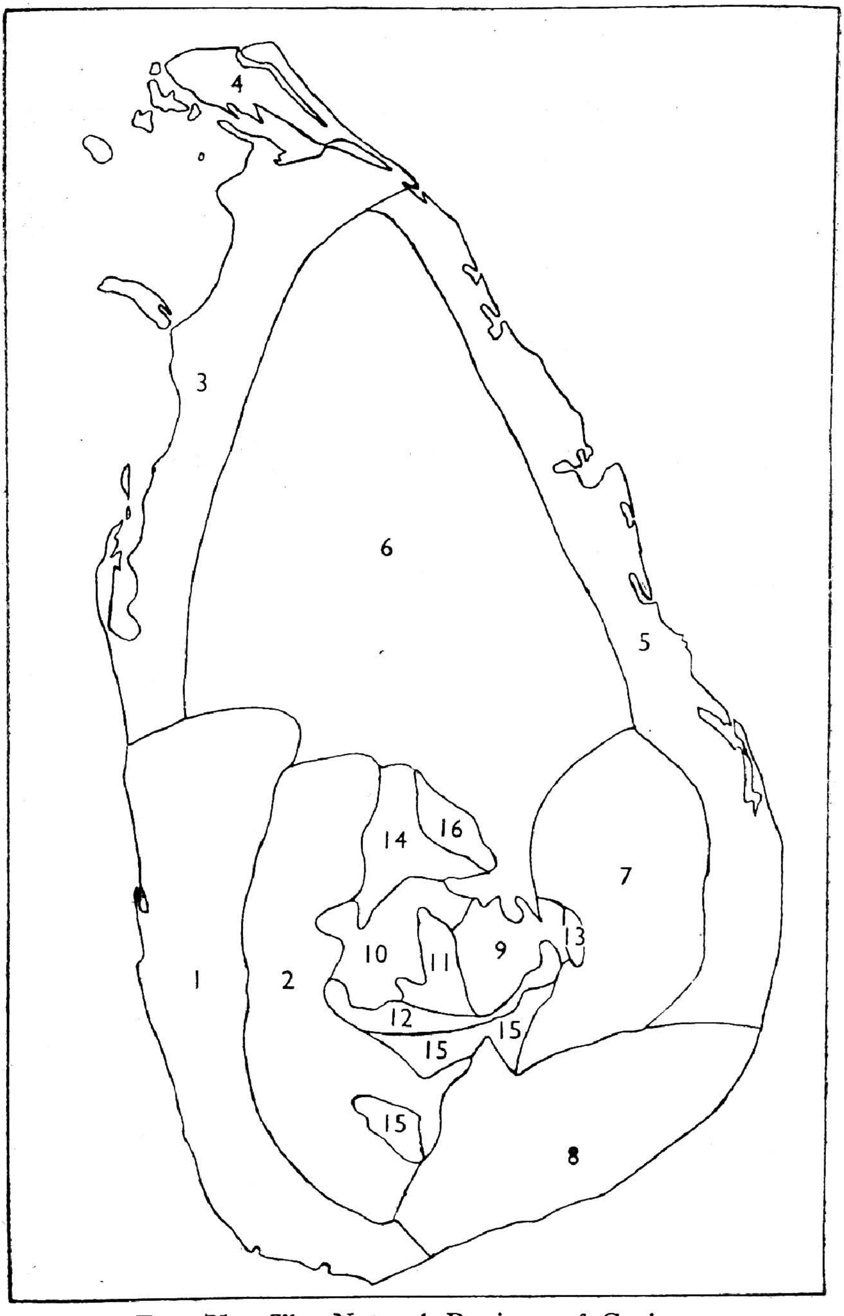


FIG. 71.—The Natural Regions of Ceylon.
(Numbering of regions as on page 194)

covered by deposits of alluvium. The hard rock lies exposed at some points of the coast, e.g. at the rocky headlands of Colombo, Mount Lavinia, Beruwala, Galle and Dondra Head. The coast itself consists of a series of spits and sandbars, behind which lies a discontinuous belt of lagoon and swamp, as at Negombo, Muturajawela, Bolgoda, Balapitiya and elsewhere. Inland from these are wide stretches of sandy soil, most of which is under coconut cultivation.

The climate is typically equatorial with a rainfall of about 75-100 inches or more, with two very wet seasons in May and October-November, and two less wet seasons in between. No month has a mean rainfall of less than two inches, and paddy can be cultivated in both *Maha* and *Yala* without irrigation. These climatic conditions do not obtain north of the Deduru Oya, nor much eastwards of Dondra Head in the south, and help to define the northern and southern limits of the region. The climatic conditions encourage the growth of plants yielding sap (palms and rubber), bark (cinnamon) and leaf (tea) rather than fruit and grain. The natural vegetation of evergreen forest has been largely cleared, except on the summits of a few hills, to make room for plantations of coconut, rubber, cinnamon, and a little tea and citronella. This deforestation has aggravated the problem of floods, which often cause distress in the lower valleys of such rivers as the Kelani, Kalu, Gin and Nilwala Ganga. Apart from providing labour for the estates, the peasants are occupied with the growing of paddy on low-lying land, and the cultivation of fruit and vegetables in the mixed gardens of jak, breadfruit, coconut and arecanut on higher ground.

This is a region where foreign influence has been most pervasive, first Arab, and then in turn, Portuguese, Dutch and British. Thus its inhabitants, who are predominantly Low-Country Sinhalese, have been the most progressive and

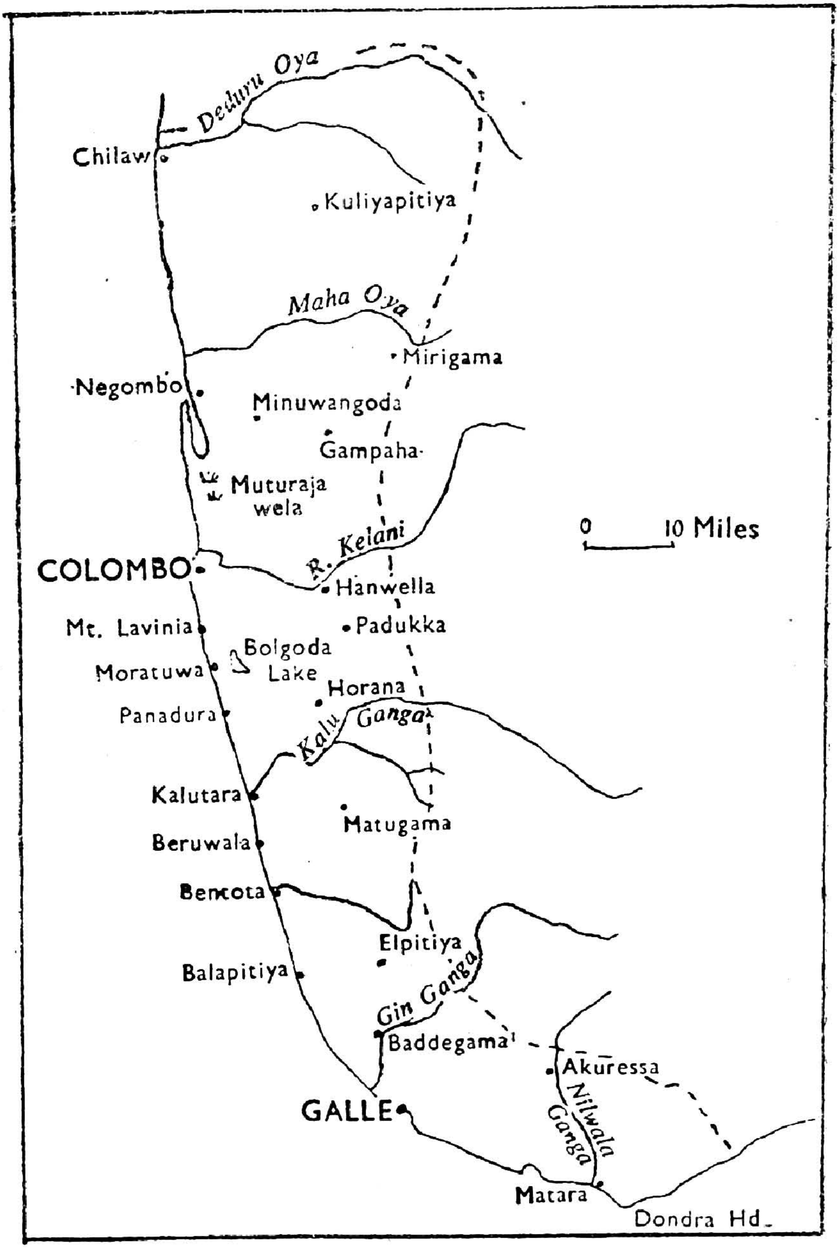


FIG. 72. The South-West Lowlands.

adaptable of all Ceylonese. It is a region where economic development has been most intense, and population density has become correspondingly great. Apart from agriculture, recent industrial development too has been largely concentrated in the south-western lowlands. This is in part due to the industrial pull exerted by Colombo, the capital and chief port of the Island. All the towns on the coast, other than those that have continued as mere fishing villages, owe their expansion and development to foreign influence. The largest towns are at or near the mouths of rivers: Colombo, Moratuwa, Panadura, Kalutara, Bentota, Galle, Matara, Negombo and Chilaw. Most of these were important for foreign trade in the days of the Arab traders, Portuguese and Dutch, but have now been superseded by Colombo. Some of them, however, have become the seats of special industries (See Ch. 15). The inland towns are overgrown villages, which have developed as evenly distributed market centres, if they happened to be conveniently situated: Kuliyapitiya, Mirigama, Minuwangoda, Gampaha, Hanwella, Padukka, Horana, Matugama, Elpitiya, Baddegama and Akuressa.

The importance of Colombo dates only from British times, with the need for communications to consolidate British rule in the Kandyan districts, and to serve as arteries of trade for the produce of the estates. It forged ahead of other towns on the south-west coast, because it commanded the easiest access to the Kandyan country (1) along the Kelani Valley and through the Ginigathena Pass, (2) along the Maha Oya and the Kadugannawa Pass, and (3) along the Kalu Ganga and Haputale Gap. Colombo was thus a suitable point for the control of routes to the north and north-east as well as to the south. These were the factors that led to its choice as the capital city and chief port for the whole Island. Its actual site was determined by the rocky headland on which the Portuguese first built their

fort, and which afforded some slight shelter for ships even before the construction of the harbour. It was this anchorage that was transformed into a harbour by the construction of a south-western breakwater in 1882. Additional breakwaters and arms to give more complete protection were added in stages and finally completed in 1912. The completion of the harbour greatly increased the importance of Colombo, as it enabled it to serve as a re-

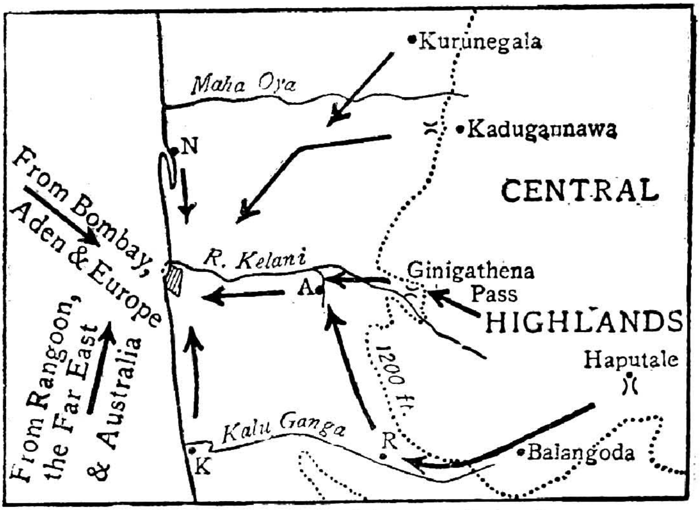


FIG. 73.—The position of Colombo.
(For other ocean routes converging on Colombo, see Fig. 2).

fuelling station for ships from Europe to the Far East and Australia. Its central position in the Indian Ocean made it a convenient point of convergence of ocean routes, and an important entrepôt not only for Ceylon products, but also for those of South India. Transport facilities have made it an important industrial town, and together with its suburbs of Dehiwala, Kotte, Kolonnawa and Wattala, it forms a conurbation of well over half a million people. Hedged in on the north and east by river and swamp, the town has expanded southwards, and many other towns on the coast between Negombo and Panadura really serve as

dormitories for the thousands who enter the metropolis daily to take part in its work of trade and administration.

Galle.—Before the construction of the Colombo harbour, Galle was, since the days of the Dutch, Ceylon's chief port, and the principal port of call for ships plying between East and West. Before the cutting of the Suez Canal, when ships from Europe had to come round the Cape of Good Hope, its position near the southern end of the Island made it a more convenient port of call than Colombo for ships proceeding to the Bay of Bengal or the Far East. Its harbour, however, opens southwards and is thus exposed to the full swell of the south-west monsoon. Besides being dangerous of approach on account of certain submerged rocks near its entrance, its small size was also a disadvantage in view of the increasing size and number of ships. As an outlet for up-country produce too, its position was not quite suitable, owing to the difficulty of negotiating the parallel south-western ridges of Sabaragamuwa to enter the interior. At present most of the trade of the Southern Province is routed through Colombo, but owing to increasing congestion in the latter port, there is some prospect of improvements to Galle harbour being effected, as it would be more convenient and economical for Southern Province trade to pass through Galle. Galle is the capital and largest town of the Southern Province.

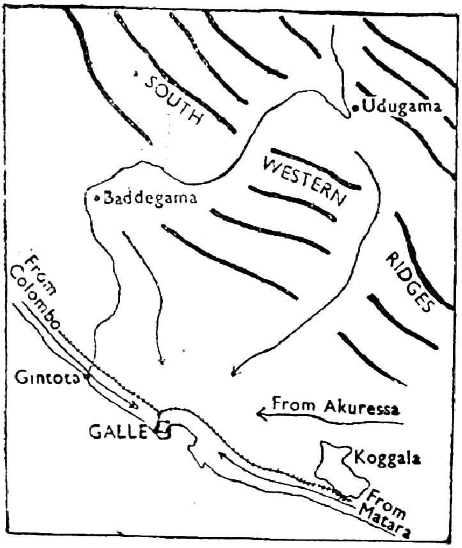


FIG. 74.—The position of Galle.

and has important jewellery and tortoise shell manufactures. Supposed by some to be the ancient Tarshish and the Kalah of Haroun al Raschid, Galle presents an old-world air and retains more traces of the Dutch occupation than any other town in Ceylon.

The Sabaragamuwa Scarpland Region is the ridge and valley country lying between the South-West Lowlands and the Central Plateau, whose edge may be taken as lying roughly along the 1,600-foot contour. Structurally an anticline from whose crest consequent rivers flowed transversely either to the south-west or to the north-east, its prolonged erosion has led to the development of longitudinal subsequent streams on the outcrops of the softer beds, while the harder beds stand out as prominent ridges between them. The gaps in the ridges form steep-sided gorges and mark the positions of the original consequents. They give a striking trellised pattern to the drainage, which is discernible even on the quarter-

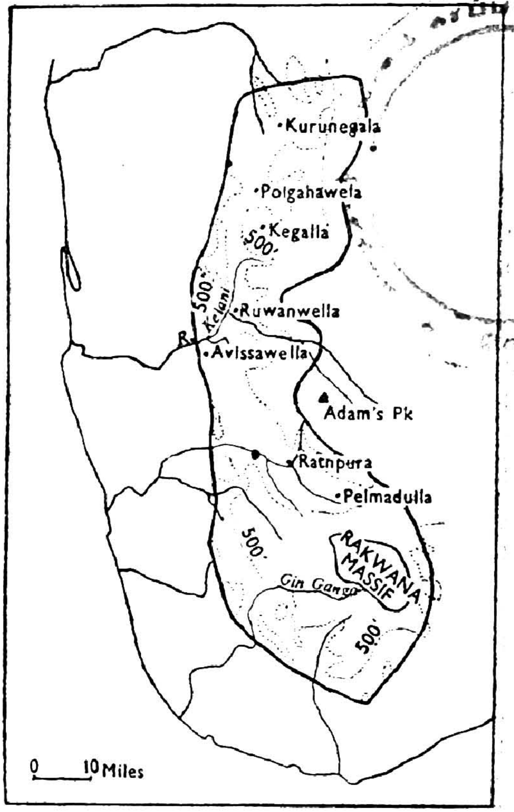


FIG. 75.—The Sabaragamuwa Scarplands.

inch map. The most remarkable of the gorges is the Nambapana gorge, through which the Kalu Ganga cuts its way to reach the coastal plain. The ridges become progressively higher in the south, and ultimately reach over 3,000 feet in the Rakwana Massif, which is really an outlier of the Central Plateau. The Ratnapura-Pelmadulla corridor is, however, an integral part of the scarpland region, and contains the chief gem deposits of the Island. The chief mineral resources of the Island, e.g. graphite and iron ore, also lie in this natural region.

The climate is similar to that of the coastal lowlands, except that it is distinctly wetter, most parts getting well over 150 inches of rain per annum. Originally covered with rain-forest which still remains in the southern portion, the northern part was largely cleared in the early years of the present century to make room for rubber, on which the prosperity of the region mainly depends. In the old days, however, this was essentially an area of Kandyan villages strung along the valley sides, cultivating paddy in the bottom lands and chena crops on higher ground. With the spread of the rubber estates, shifting cultivation practically ceased in the north, and there was much immigration both of Indian Tamils to supply labour, and

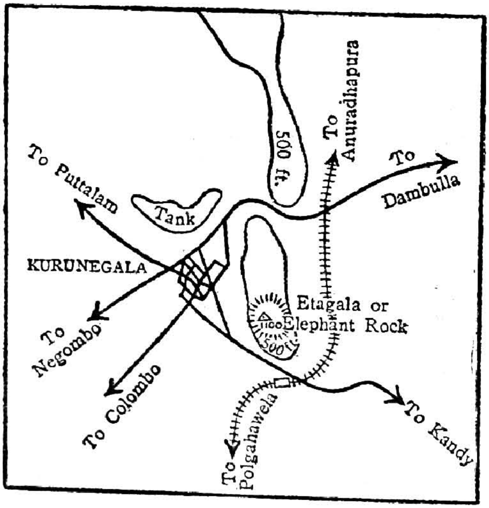


FIG. 76.—The position of Kurunegala.

of Low-Country Sinhalese to engage in trade and supply the needs of the estate population.

The chief towns are Kurunegala, the capital of the North-Western Province, Ratnapura, the city of gems and capital of Sabaragamuwa, Kegalla, Ruwanwella and Avissawella. Around Kegalla there is much cultivation of arecanut and papaw. Ratnapura has a beautiful site at a bend of the Kalu Ganga, which flowing south from Adam's

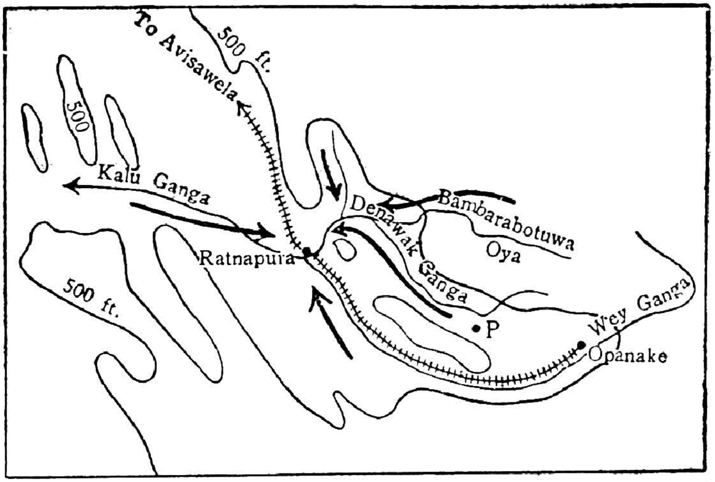


FIG. 77.—The position of Ratnapura.

Peak, is here joined by the Wey Ganga. Though liable to flood, its position is one of great nodality, as the Denawak Ganga and the Bambarotuwa Oya join the main stream only a couple of miles above the town. Lying in the very shadow of the Peak, it is much thronged by pilgrims in March and April, some of whom consider the steep and rugged climb from Ratnapura far more meritorious than the less arduous ascent by way of Hatton and Maskeliya. Plumbago mining, which is principally carried on near Ruwanwella and Kurunegala, is also important around

Ratnapura. Pelmadulla is the other centre of the gemming industry.

The southern part of the region is one of sparse population and rugged relief, with a thinly scattered population living isolated in the valleys of the great Sinharaja Forest, and carrying on their traditional mode of life undisturbed by frequent communications with the outside world.

EXERCISES

1. Distinguish between structural, climatic, natural and geographical regions.

2. Write a concise geographical account of the South-West Lowlands of Ceylon.

3. Attempt a descriptive geographical account of the basin of the Kalu Ganga. Illustrate your answer with a sketch map.

CHAPTER 20

NATURAL REGIONS (*Continued*)

THE REGIONS OF THE DRY ZONE

The North-West Coastal Plain.—Except for the area around Puttalam and the extreme south, where there is a good thickness of Pleistocene and more recent deposits, this coastal plain is composed of sedimentary limestone of Miocene age. The limestone is, however, covered by recent sand dunes on the coast and by Pleistocene gravels inland, with occasional bands of river alluvium. The rainfall is lowest at Marichchukkaddi, the pearl-fishery centre, where it is 37.8 inches, and increases both northwards and southwards. The natural vegetation is thorn scrub and palmyra. Population is very sparse, and along the coast it is dependent on fishing and the collection of salt. Advantage has been taken of the dry climate to set up the chief state salterns at Elephant Pass, Palavi and Mannar.

The coconut cultivation of the south-west lowlands has extended a little north of Puttalam, and inland, there are two regions of extensive paddy cultivation. These are based on the Aruvi Aru at Murunkan, Mantai and Silavatturai, and on the Kanakarayan Aru at Kilinochchi. Between the Aruvi Aru and Kanakarayan Aru are a number of streams which run dry during *Yala*, but there is some cultivation of paddy at Pooneryn based on a few small tanks.

As this coast has been the chief landing ground for invaders from India, it has received much foreign influence and the population is somewhat mixed, with a strong Moorish element round Puttalam. Puttalam also contains a Kaffir element, as well as a community of Christian Tamils

known as Mukkuwas, supposed to be descendants of craftsmen brought over from India in the times of the Sinhalese kings. Mantai (ancient Mantota) was the earliest port on this coast, but Mannar, on the Island of Mannar, has become the chief town since the construction of the Indo-Ceylon railway, which threads the island after passing through Murunkan in the Giant's Tank irrigation area. Apart from the trunk road which runs alongside this railway, and a few feeder roads between Murunkan and Mantai, this coastal belt is served by little more than a cart track beyond Puttalam and Kalpitiya. Northwards from Mantota there is a road with some semblance of continuity, except for a break of eight miles at the 20th milepost, connecting Mannar with Pooneryn on the Jaffna Lagoon.

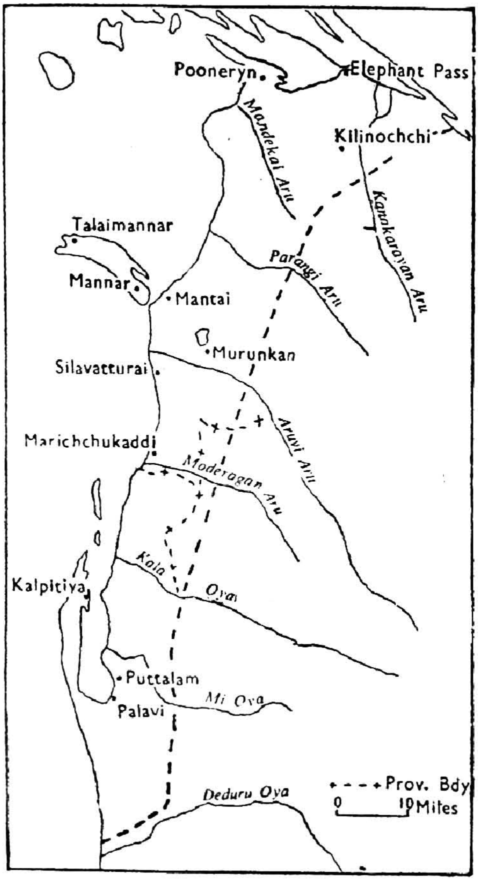


FIG. 78.—The North-West Coastal Plain.

The Jaffna Peninsula and Islands.—The peninsula differs from the mainland portion of the Jaffna District in containing no rivers at all. The Miocene limestone of which the peninsula is built, being a hard compact rock, is much

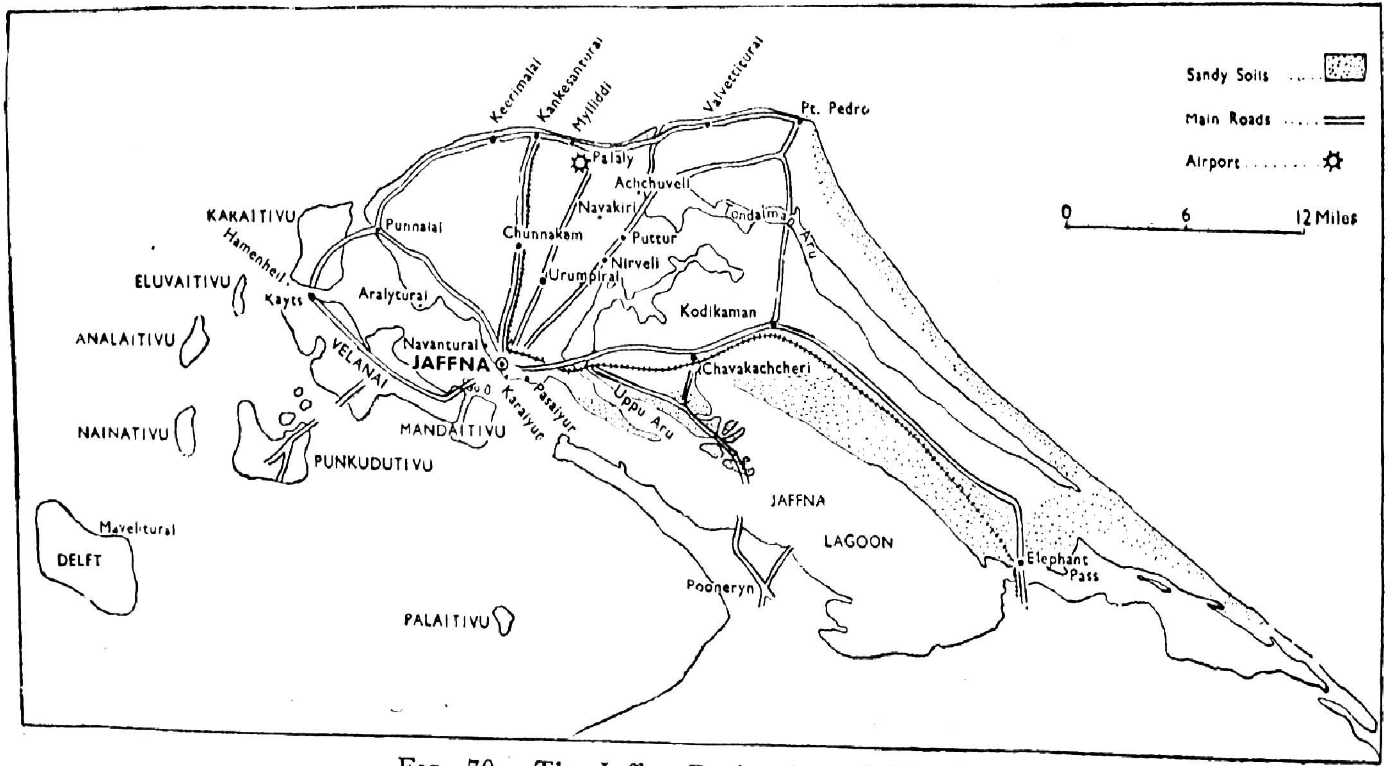


FIG. 79.—The Jaffna Peninsula and Islands.

jointed, and rain water charged with carbon dioxide from the air greatly enlarges the joints, as it percolates through them. Water therefore does not remain for long on the surface, but drains away quickly underground, where it forms an intricate network of subterranean streams, springs and reservoirs. Keerimalai, the famous bathing resort, is such a spring. Fortunately the peninsula is flat and low-lying, and this water can easily be tapped by shallow wells. The water is, however, very hard, being heavily charged with calcium carbonate, and is not very palatable, except to those who are used to it. Also, below a certain depth sea water enters the underground circulation, and in the digging of wells the cultivator has to take the greatest possible care that he does not reach the depth where the water becomes brackish. (See also p. 99). Some parts of the peninsula are below sea level and the sea runs into them to form lagoons, the Tondaiman Aru in the north and east, and the Uppu Aru in the centre and south. Only in the north-east does the land rise as much as fifty feet above sea level, where the North-East Monsoon has thrown up sand to form a belt of dune country, extending the whole length of the peninsula south-eastwards from Point Pedro. The south coast to the east of Jaffna town is also sandy country. Along the north and west coasts the hard limestone rock appears at the surface. Such areas of bare rocky country also occur elsewhere, but particularly in a belt in the middle of the peninsula, running north-eastwards from Jaffna and to the west of the Uppu Aru. Such land is only suitable for quarrying, and is uncultivable unless reclaimed. The Kankesanturai cement factory is situated on such land. Reclamation is by digging, blasting and levelling, an expensive process. It is said that a fair proportion of land now under cultivation is rocky land that has been reclaimed within the last century. On the land bordering the two inland lagoons, the soil is too saltish for

cultivation. Elsewhere the limestone has decomposed on the surface to form a grey loam at lower levels where the drainage is imperfect, and a red loam on slightly higher ground.

Climatically, the year may be divided into two seasons, the cool and the hot, each with subdivisions of wet and dry. Thus the cool season begins with the rains in October and lasts till February, with a maximum of rain in November. This is the main cultivation season (*kalapokam*). Occasionally the rains fail, causing a total loss of the crops sown. At other times the rains may be excessive, with similar results. February is cool and dry. The latter part of March marks the commencement of the hot season, and is accompanied by light convectional rains which last till May. June to September is the season of the south-west monsoon (*sirupokam*), when the steady monsoon wind causes a drop in temperature by increasing the rate of evaporation. It also raises a good deal of dust and sand, and tobacco and plantain gardens have to be protected from the sand blast by high fences—a characteristic feature of the whole Peninsula.

Though both the grey and the red soils are poor, they are manured so heavily, that as many as three crops are raised in one year on the same land. Apart from leaf and animal manure, all house and garden sweepings and refuse of all kinds are skilfully ploughed into the soil. Hedges are planted with Gliricidia, Tulip (Suriya), and Dadap (Eramudu) to provide a fair proportion of the leaf manure required. Sheep, cattle and goats are penned in movable sheds in all plots of land left fallow, so that their droppings may cover the entire field. All land that can be asweddumized is planted with paddy in the November rains. Higher land that cannot be asweddumized is devoted to tobacco, chillies, onions and vegetables. Immediately after the paddy harvest, sunn-hemp (*Crotolaria juncea*), a

legume, is sown with the moisture still in the soil. This crop restores nitrogen to the soil, yields fodder for cattle, and gives a small cash return if the stalks are sold. On high land, wherever adequate supplies of well water are available, gingelly and green gram are grown. Subsidiary crops such as chilly, onion, gingelly or vegetables are also grown on paddy land in *sirupokam* till October, and are as paying as those crops cultivated on high land. They also considerably improve the yield of the subsequent paddy crop, the paddy seedlings having been raised meanwhile by well-irrigation for transplanting. This is to avoid the risk of damage to the crop by subsequent failure or excess of rains.

Definite forms of crop rotation are practised. The commonest rotation is tobacco and a cereal followed by a legume, such as green gram. In recent years, onion which was given a remunerative guaranteed price has replaced the cereal. Onions are also grown as a mixed crop on the edges of water channels in a field of kurrakan or other cereal. Plantains are usually cultivated as part of a five year rotation. Manioc is often grown as a rotation crop mainly on land which requires cleaning. It occupies such land for six to eight months. Besides these annuals, perennial crops such as coconuts, and fruit trees such as mango, citrus, jak, pomegranate and drumstick are cultivated. The palmyra is not systematically cultivated, being mainly the result of fallen fruits allowed to grow unattended. Because of the difficulties attendant on coconut cultivation, the palmyra is the most widely useful of all the trees. Palmyra will serve as a wind-break and shade-tree, and will grow where nothing else will succeed. The peasants use its timber to build their houses, and its leaves to thatch their roofs and fences, or to make baskets and fans. Panmaddu can be made from the pulp of the fruit. The roots of the seedling make kottaikelengu,

which can be eaten boiled, dried or made into flour. The tender leaves and young fruit are used as fodder. Toddy can be tapped from the palm, and jaggery and arrack made from it. About 50,000 acres are estimated to be under palmyra in the peninsula and on the islands. Of the Islands, Eluvaitivu has the largest acreage of palmyra. Fishing is an important occupation along the coasts and islands, chanks and sea slugs being specialities. The sea slug is a sluggish creature about a foot long. It is dried and exported to China, where it is used for soups. The chief collecting centre for sea slugs in the peninsula is Navanturai, about two miles to the north of Jaffna. Other fishing centres are Karaiyur, Pasaiyur, Aralyturai, Kayts, Myiliddy and Point Pedro.

The islands have much the same occupations as the peninsula; but everything, including the rainfall, is on a poorer scale. Potable drinking water is hard to come by, particularly in the outer ring of islands. Varagu (Amu) is the second cereal in the islands. Delft, the remotest island, is separated by deeper water from the others, and is difficult of access in the South-West Monsoon. Varagu is its principal cereal. Delft used to be a breeding centre for horses in Dutch times. It has scarcely any land under paddy, but some fodder crops are grown.

In spite of much waste land in the rocky and sandy areas, the average density of population in the peninsula and islands works out to over 1,000 persons per square mile. Of the 414,000 people in the region, Jaffna town alone had, 77,000 or 18.6 per cent. It is the only predominantly urban centre, the other towns being fishing *cum* sea ports, or village markets. The town is situated at the south-west corner of the peninsula, at the first point in the approach from the mainland, where good agricultural soil abuts on the coast with access to the open sea. It is thus suitably placed to be the chief distributing and administrative centre

of the whole peninsula. All the ports including Jaffna are mere shallow roadsteads, suitable only for small vessels. Those on the north coast like Point Pedro, Valvettiturai and Kankesanturai have no protection from the North-East Monsoon. The best prospects for port development in the peninsula seem to be at Kankesanturai, with the cement factory, power station and air port close at hand. It has complete protection from the South-West Monsoon, and with the exception of Jaffna is the only port served by the railway. The chief port of the north at present is Kayts (ancient Uratota), whose harbour is the channel between Karaitivu and Velanaitivu, with which the islet of Hammenheil combines to give complete protection for shallow craft from both monsoons; but vessels of even 300 tons have to lie in the outer anchorage, two miles north-west of Fort Hammenheil, and discharge part of their cargo before entering Kayts. Kayts carries on a trade with the South Indian ports of Negapatam, Karaikal and Cuddalore.

The Eastern Coastal Plain is a narrow lagoon-fringed belt extending from the delta of the Wila Oya in the south to beyond Mullaittivu in the north. It is divided into two sections by the Khondalite ridges which reach the sea at Trincomalee. The northern section, with a few exceptions, receives several short rivers liable to dry out, but the southern stretch is watered by longer and more reliable streams, taking their rise in the Central Highlands, and including the great Mahaweli Ganga, which enters the sea just south of Trincomalee. Near Trincomalee are the famous hot springs of Kanniyai of reputed curative power. The Mahaweli Ganga has two main outlets, one into Koddiyar Bay and the other into the open sea at Verugal, and the area between them is virtually its delta, capable of supporting a dense population, once the river is adequately controlled by the completion of the various schemes in progress higher up its basin. Except in the extreme north

and south, the east coast receives a greater rainfall than the other parts of the dry zone, the southern stretch with a single maximum in December from the North-East Monsoon, and the northern stretch with its principal maximum in November, and a smaller one in May. The relatively high temperatures of June and July are due to the Kachchan (See pp. 47-8). Land communication, particularly north of Batticaloa, is made difficult by the numerous stretches of water, over which there are only slow and infrequent ferry services. South of Batticaloa the coastal road crosses the rivers by causeways, but even here as in the north, traffic is liable to complete interruption by floods round about December. The greatest density of settlement is on the coastal strip bordering the Batticaloa lagoon, and southwards towards the Gal Oya, but the north is much more sparsely settled, except for some clusters of population in the vicinity of Koddiyar Bay and Trincomalee. Throughout the region rice and coconuts are the mainstay of the villages. The latter border the lagoons and have their backs to the sea, separated by infertile and desolate stretches of dune country. Here particularly in the north are found a number of temporary fishing camps set up by fishermen who migrate from the west coast during the South-West Monsoon.

The tanks of Rugam, Unichchai and Mannalpuddiaru irrigate the second largest stretch of paddy land in Ceylon, and one that is almost continuous with the paddy lands of the Gal Oya basin. The new reservoir at Inginiyagala will do much to benefit this area. Distinctive rectangular-shaped plots form islands in a sea of alluvium, and afford firm ground for the settlements of the cultivators, who are usually tenants of absentee Moor landlords. But the densest settlement is in the coconut groves on the other side of the lagoon, where fishing provides an additional means of sustenance. The jungle and swamp adjoining the water

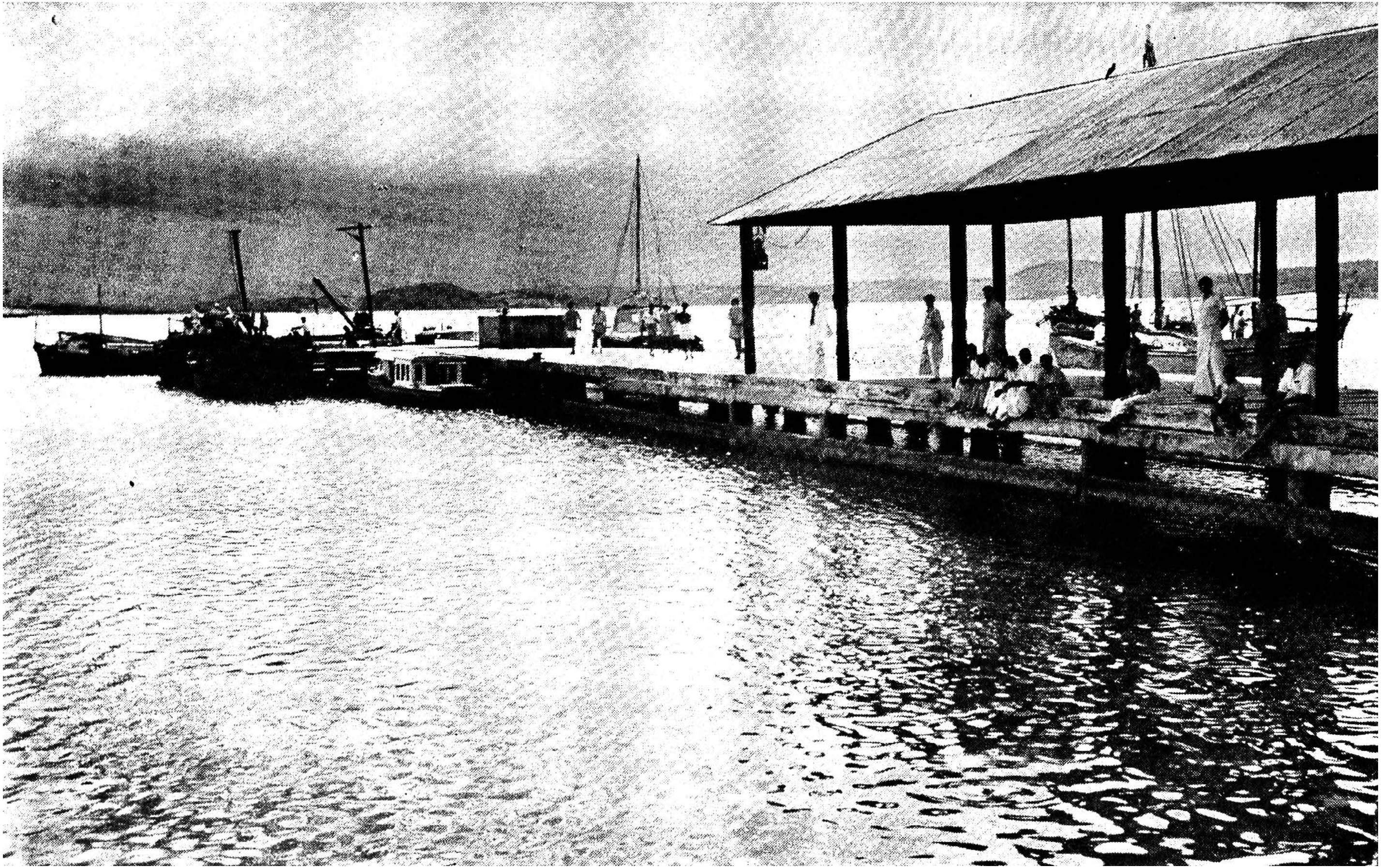
bodies teem with game and are the sportsman's paradise. The collection of salt is important in the north, e.g. at Nilaveli; and some tobacco is grown, e.g. at Eravur and Verugal. Other crops are ground-nuts especially in Tampalakaman Pattu, and cashew in Koddiyar Pattu. Both these crops are capable of much extension.

The inhabitants are chiefly Ceylon Tamils, but in the south there are a good number of Moors and even some Tamil-speaking Sinhalese, e.g. around Pottuvil. Trincomalee and Batticaloa are the largest towns, and have direct communications with the hill-country and the west, though Batticaloa is the more remote. Trincomalee, on the northern side of Koddiyar Bay, owes its importance to its fine capacious natural harbour with its many enclosed bays, such as Cod Bay and China Bay. Being the only natural harbour in the entire Bay of Bengal, it early attracted the attention of the British, who captured it from the Dutch in 1795. The numerous ridges and hills around it served in those days to give it a strongly defensible site. The completely landlocked nature of its harbour, with Fort Ostenburg and the Great and Little Sober Islands guarding its entrance, give it complete protection from both monsoons. Though the Koddiyar Bay region was an outlet for the country in Kandyan times, it has since then had no commercial importance whatever. This is because it is cut off by wide tracts of uninhabited jungle from what was in British times the principal region of commercial agriculture. It was only in 1920 that Trincomalee was connected with Colombo by a light railway. In recent years its fortunes have fluctuated with the degree of use made of it by the

PLATE 3

Trincomalee Harbour and Customs Landing Jetty.

[C. P. Koch



British Navy. Thus the fall of Singapore in the Second World War brought it into prominence, making it Britain's chief naval base in the East, and its population increased from 10,161 in 1931 to 32,507 in 1946, a phenomenal increase of 270 per cent in the intercensal period, and one unmatched by any other town in the Island. By 1953, however, its

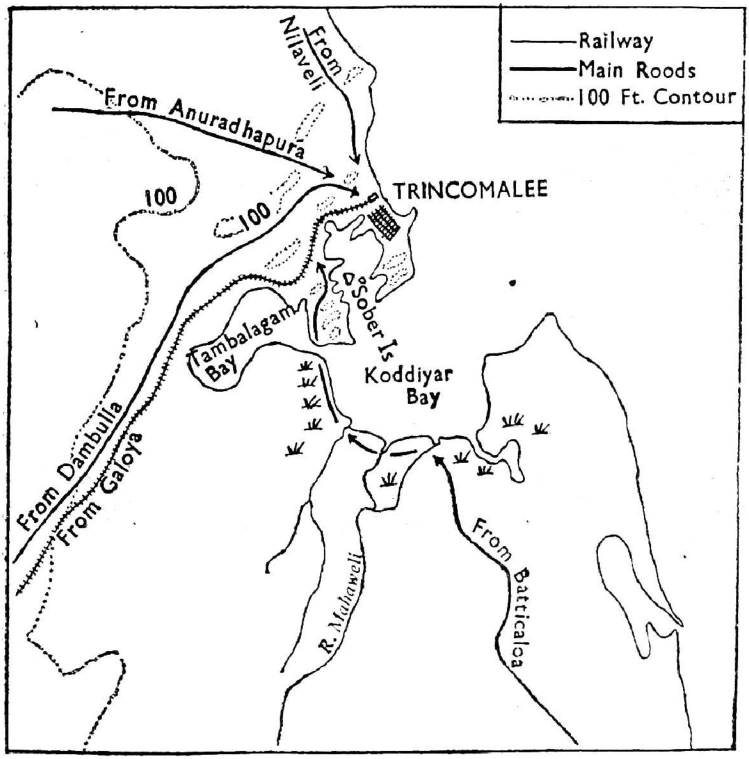


FIG. 80.—The position of Trincomalee.

numbers had declined to 28,236, as a result of the closing down of many works run by the Services. Though the great development schemes in its hinterland are more concerned with the growing of food for home consumption, the increasing congestion in the port of Colombo, and the necessity for developing some northern port in connection

with salt and cement manufacture, and the export of ilmenite and other sands from the east coast, has led to the investigation of the claims of either Trincomalee or Kankesanturai for development as a commercial port. If the development of Trincomalee is preferred to that of Kankesanturai, it would be necessary to provide more direct rail communication with Jaffna, by a branch line from Vavuniya, as recommended by the World Bank Mission.

Batticaloa, the other eastern port of Portuguese and Dutch times, is the capital of the Eastern Province, and is situated at the entrance to the muddy lagoon (Sinh. *mada kalapuwa*), from which it derives its name. Three roads link the town with the rest of the Island, the coastal road with Trincomalee and Pottuvil, the main road with Badulla, and the Manampitiya road with Polonnaruwa and Minneriya. It is now of added importance as the railway terminus for the area served by the Gal Oya Development Board. As a port, however, its importance is now negligible, as it can only be used by small sailing vessels. In the days of the round-the-Island steamer service before the construction of the railway, it was more important as a port, when the steamers used to cast anchor one mile to the east of the bar, but this was not possible in the North-East Monsoon, when Kalkudah Bay which could be used throughout the year was used instead. The shallow Bay of Pasikudah immediately to the north of Kalkudah is a beautiful bathing resort and deserves to be better known as such.

Mullaittivu in the extreme north is a fishing port. Some cultivation of paddy, vegetables and tobacco based on the Kanukkeni tank is carried on here and in the neighbouring village of Tanniyuttu.

The North-Central Tank Country includes the greater part of the North-Central Province, the Vavuniya District of the Northern Province, and also the adjoining parts of the

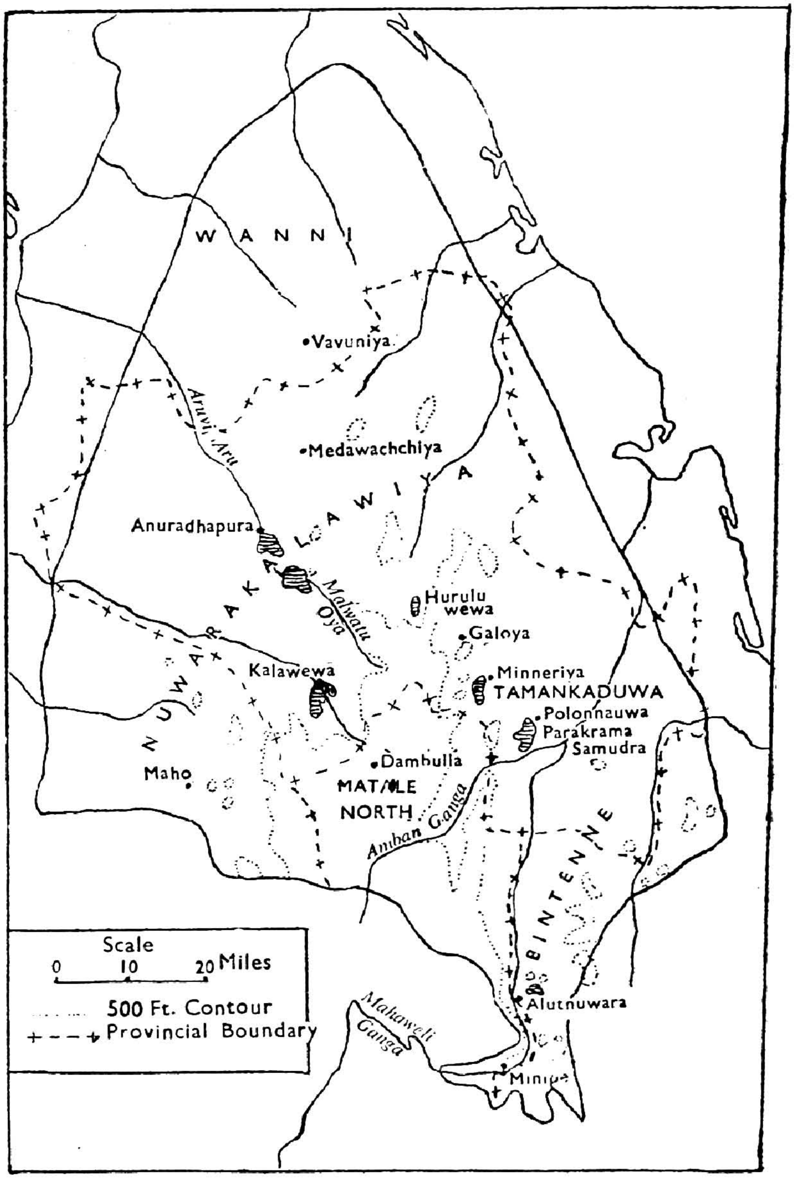


FIG. 81.—The North-Central Tank Country.

Mannar District, North-Western Province, Central Province and Eastern Province. This is roughly coincident with the ancient Raja Rata, but with a southerly extension along the Mahaweli Ganga into Bintenne as far as Minipe. It may be divided into five sub-regions: the ancient districts of (1) Nuwarakalawiya, (2) Tamankaduwa, (3) Wanni, (4) Bintenne, and (5) North-eastern Matale. The entire region is over 100 feet in elevation, and though for the greater part a plain, is diversified by rocky ridges and isolated hills, with a gradual rise to over 1,000 feet towards the central Hill-Country.

Though the mean annual rainfall appears to be moderate, its chief characteristic, as in the Mannar and Jaffna regions, is its variability, and drought is the great problem. *Yala* is always dry. October usually ushers in the rains, but these are sometimes late or feeble. The 'little monsoon' rains are markedly fickle. The unreliability of both the early and late rains is due to the fact that they are largely dependent on the occurrence of cyclonic depressions. Mean monthly rainfall figures are misleading, and should not be adopted as a measure of the rainfall that may be expected for any month. The median rainfall of a reasonable number of years is a better index of rainfall expectancy, but even so, evaporation rates are so high, that the region is subject to long spells in which the rainfall is generally inadequate to preserve soil moisture above wilting point.[1] Except for the areas watered by the Mahaweli Ganga, the problem of maintaining soil moisture is of greater difficulty than in the Eastern Coastal Plain because (1) the rivers take their rise only in the outskirts of the Hill-Country; and (2) unlike in the Jaffna limestone there are no large reserves

[1] B. H. Farmer has pointed out that a study of the climate in terms of the expectancy of effective rainfall is of particular applicability in the development of the Dry Zone. (See Bulletin of the Ceylon Geographical Society, Vol. VI, No. 2, December 1951.)

of underground water, and little is known of the behaviour of the water-table in many parts.[1]

The soils are not fertile; there is relatively little alluvium, and slopes are sufficient to complicate irrigation and induce soil erosion. The soil becomes readily degraded and eroded when the forest cover is removed; especially so after heavy falls of rain.

The innumerable abandoned tanks and channels that are found in all parts of the region are a witness to the density of settlement that must have prevailed in ancient times in this cradle of Sinhalese civilisation. The prosperity of the region was based on rice cultivation, which preserves something like an irreducible minimum of fertility even on infertile soils, while the virtual certainty of two dry seasons enabled two crops to be successfully harvested whenever irrigation was sufficiently advanced to ensure an adequate supply of water. Except for the capital city, there were no towns of any size; the economy of the region was primarily agricultural and rural, its villages were surprisingly self-sufficient and remain so even today, except where nearness to arterial lines of communication have caused this to be modified by the impact of a money economy. Abandoned since the thirteenth century as a result of war and pestilence, it is only since the 1940's that the eradication of malaria by the use of DDT has given hopes of the successful resettlement of this 'Granary of the East'.

Agriculture is characterized by a threefold system of land use, and is based on the tank. Each settlement consisted of a stretch of low-lying paddy land—the *yaya* or *madabima,* an area of higher ground—the *gangoda* or garden land on which the houses were built, and thirdly a vast stretch of jungle land or *gamvasiya,* on which the peasant

[1] The water-table is the upper surface of underground water. It is the level to which water will rise in a well. This level fluotuates with the season in regions of seasonal rainfall.

practised chena cultivation. The garden land contains a variety of fruit trees, vegetables and other useful plants,

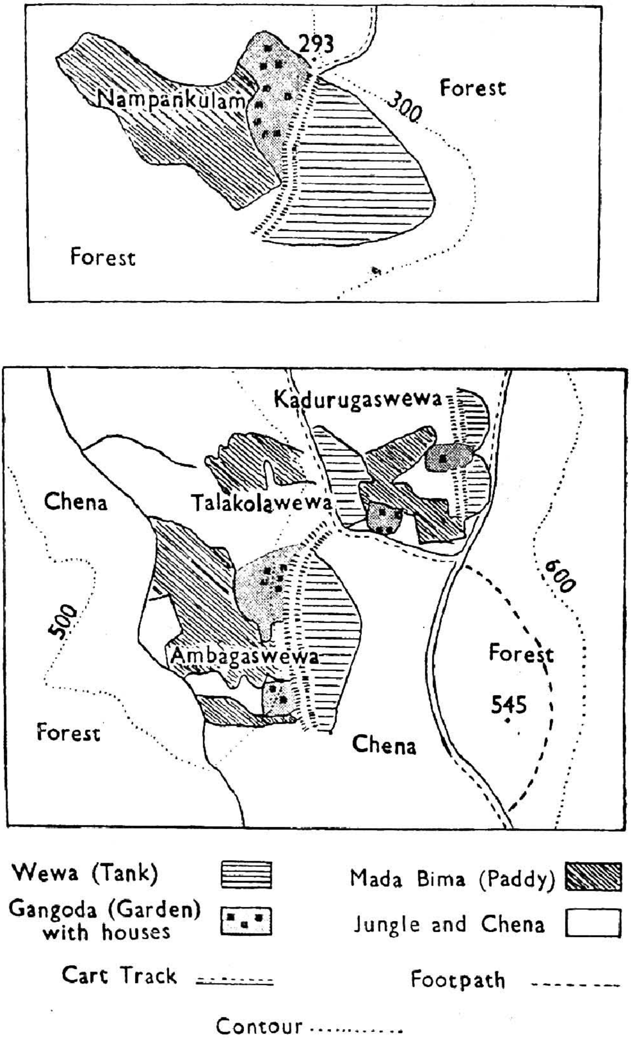


FIG. 82.—Tank Settlements.

the chief of which is the coconut. Other common trees are jak, breadfruit, mango, arecanut and papaw. Only a few

of these like the mango and tamarind are naturally adapted to the dry zone. The other trees are able to grow because the water-table is maintained within reach of the roots by proximity to the tank, and may find themselves in difficulties in a drought severe enough to dry up the tank. The gamvasiya, besides being used for chena, serves also for pasturing cattle, as a source of timber and wild vegetable products, and also for hunting. The patch for chena is chosen from

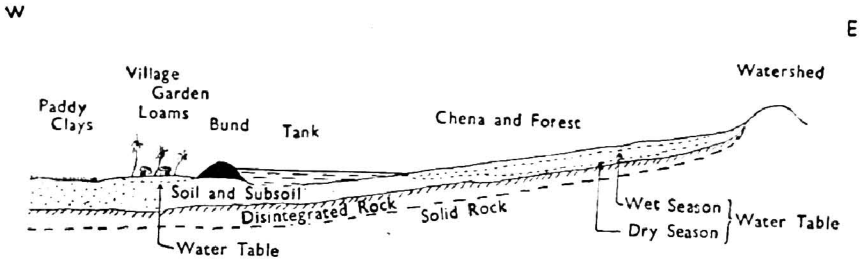


FIG. 83.—Generalised section across tank settlement. (Scale greatly exaggerated.)

relatively high jungle, roughly cleared by burning, during *Yala*, and sown with dry grain crops, manioc or sweet potatoes, and *elvi* (hill-paddy) in water-logged situations. After a year or two the chena is abandoned, when proliferation of weeds becomes too much for the cultivator. Abandoned chenas in Nuwarakalawiya usually show a plant succession from weeds through scrub and secondary jungle to something resembling high jungle. Chena cultivation, in this region at any rate, has undoubtedly enabled the continuous use of high land without impairing the soil. The crop depends mainly on the nitrogen and minerals made available by the burning; the reservoirs of nutriment in the soil are largely untapped, in any case, they are restored after a few years of recuperation. The rank growth of weeds is really a blessing in disguise; for it not only forces the cultivator to abandon his patch before

damage is done to the composition and structure of the soil, but also serves to check erosion. On the other hand, the chena system is extremely harmful on steep slopes, or on very light, easily erodible soils as in Bintenne, and its ill effects become more pronounced, when the population increases beyond a certain critical density, causing too rapid a chena cycle, as in the Kalawewa region. Also, as Farmer

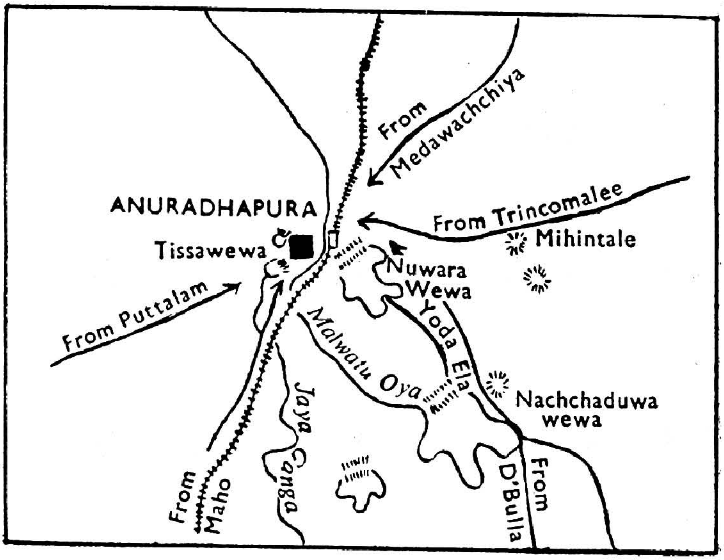


FIG. 84.—The position of Anuradhapura.

has pointed out[1] in new colonization schemes, such as Minneriya, Parakrama Samudra and Minipe, clearing of jungle lands by mechanized methods will be attended by more soil erosion and desiccation than chena, because large continuous tracts are cleared, stumped and kept clean. Under such conditions, coconut, jak and other moisture-loving trees have perished, and it may be necessary to fall back entirely on trees well adapted to drought, such as

[1] See B. H. Farmer: Problems of Land Use in the Dry Zone of Ceylon, Geographical Journal, Vol. CXX, Pt. I, March, 1954.

mango or palmyra. Recent experiments in dry-farming, e.g. at Kurundankulama, about five miles to the east of Anuradhapura, have been directed to determining the conditions under which the peasant can make a living from unirrigable high land in the dry zone without imperilling the soil.

Anuradhapura, the Sinhalese capital from the fourth century B.C. to the eleventh century A.D., is the chief route centre and capital of the North-Central Province. The factors which seemed to have favoured its siting and development are (1) its central position, (2) the proximity of several hills from which the surrounding countryside could be surveyed, and movements of an enemy observed, (3) its command of the route along the Aruvi Aru taken by invaders from India, (4) its position on the Malwatu Oya, which was suitable for the development of large scale irrigation, and (5) the fact that the valley of this river provided a routeway to the retreats of the hill-country. The extension of the railway to Anuradhapura at the end of the nineteenth century, not only led to the restoration of the irrigation works of the city, but also increased its importance as a tourist centre and pilgrim resort. Its population, which was only 702 persons in 1871, had increased to 8,975 in 1931, and to 18,431 by 1953. In order to prevent further obliteration of its interesting ruins and preserve the sanctity of the sacred city of yore, a new town is being built to the east of the Malwatu Oya.

The other area which has seen a great influx of population, is that round Polonnaruwa, which succeeded Anuradhapura as the metropolitan area. In 1953 it was raised to the status of an administrative district. In modern times the railway and the restoration of the tanks came here much later, but it was only with the inauguration of the great colonization schemes in 1932 that this area began to be settled. While between 1921 and 1931 the region actually

registered a decline in population, by 1946 the population had increased by 12,902, and in 1953 by an additional 37,000, a percentage increase of 625 in 22 years. The scheme of aided irrigation in this region has been described as one of the most generous of similar projects in any part of the world. Apart from rice cultivation, the production of citrus and other fruits is of increasing importance in the district. Much experimental work in livestock farming and sugar-cane cultivation has been carried out here in recent years. At the Government Livestock Farm at Polonnaruwa, Indian breeds of cattle and goats are raised, while attempts are being made to establish pasture and fodder suited to dry-zone conditions. The Department of Fisheries has also established its main centre for developing fresh-water fisheries at Polonnaruwa.

Other route centres of Rajarata are Dambulla, Vavuniya, Alutnuwara and Medawachchiya. At Vavuniya it has been found possible to carry out irrigation from wells, and with the restoration of tanks in the neighbourhood, intensive cultivation of crops is becoming possible. Vavuniya is noted for oranges. Alutnuwara will increase in importance when the projected road to Padiyatalawa and Inginiyagala is completed.

The Eastern and South-eastern Foot-hills.—This is a region of confused relief and comprises the upper basins of the Maduru Oya, Mundeni Aru, Gal Oya, Heda Oya and Kumbukkan Oya. It includes the eastern third of Uva and the adjoining parts of the Batticaloa District. Though reaching down to altitudes below 200 feet, the larger part of the region represents the eastern portion of the second peneplain (see p. 14), dissected here rather irregularly, because it has developed on the gneisses of the Vijayan series, which lack the regular alternations of hard and soft bands characteristic of the Khondalite country of the south-west. Some of the peaks rise to well over 2,000 feet, e.g.

Kokagala, Friar's Hood and Moneragala. In the north an intrusion of igneous rock in the form of a dyke runs in a N.W.-S.E. direction for nearly 40 miles in the Eastern Province, (see Geological Map, Fig. 7). This dyke, known as the Kallodai dyke, forms a well-marked feature contrasting sharply with the banded gneisses which surround it, and its outcrop is marked by a line of boulders. A number of deep-seated springs, some of hot water, occur in several localities, especially in the valley of the Mundeni Aru.

Though the annual rainfall is well over 75 inches, the region is climatically part of the dry zone, and, as it contains hardly any tanks, has always been sparsely populated. Apart from the Wellawaya-Pottuvil road, only one other road traverses the region, that from Moneragala to Maha Oya through Bibile. The Gal Oya Development Scheme and the construction of more direct roads to it from the Central Province should do much to open up a region that has suffered so much from isolation in the past. The unifying character of the whole region is its savannah vegetation, variously described as talawas, damanas and villus. Some paddy is cultivated near the borders, e.g. at Wellawaya, Buttala, Moneragala and Bibile, but elsewhere there has only been chena cultivation of kurakkan, maize and other dry grain crops. The region seems to be well suited to fruit farming, an activity at present confined to Moneragala and Bibile, which are both noted for oranges. There is some rubber and a little tea in the Moneragala hills. The country between Maha Oya and the Senanayake Samudra was the last resort of the Veddahs and contains a number of Veddah villages, e.g. Mullagama, Bingoda and Pollebedde.

The South-Eastern Lowlands.—The Hambantota-Yala arid belt, marked by the annual isohyet of 50 inches, forms the heart region of the South-Eastern Lowlands, but we

have also included in this natural region a border zone of about twelve miles width just outside this isohyet. Thus defined the region would include almost the entire Hambantota District, the south-eastern triangular extremity of Sabaragamuwa and the southern portion of Uva. It is roughly coincident with the densely settled part of the ancient Sinhalese kingdom of Ruhuna. It is with one exception a region of lowland, rising gently in the north to a little over 500 feet in a few spurs and outliers of the

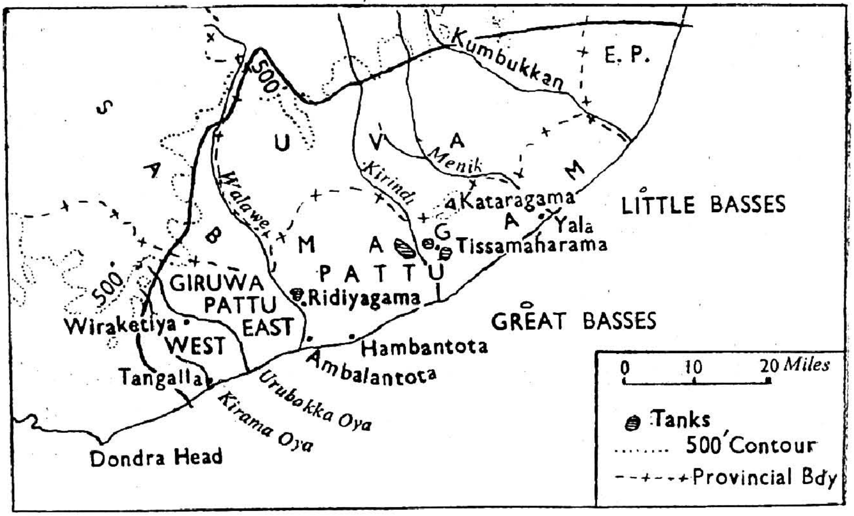


FIG. 85.—The South-Eastern Lowlands.

Central Hills, and traversed by several rivers, such as the Walawe, Kirindi, Menik and Kumbukkan Oyas, flowing generally south-eastward to a lagoon-fringed coast of kalapuwas and lewayas. The only variety in the landscape is provided by the residual hills of Kataragama, which divert the Menik Ganga to a more south-easterly course. Climatically it resembles the north-west coast, the village of Yala having the lowest annual average rainfall for the whole of Ceylon, but towards the west the dry season is not so pronounced, Tangalla and Wiraketiya having a fair

amount of rain in *Yala*. Of the legendary hot springs of Ruhuna, the best known is the one at Mahapelessa, about two miles north of Ridiyagama tank.

The natural vegetation is dry zone forest in the west, and scrub and park country in the east, but in much of the two Giruwa Pattuwas the forest has been replaced by scrub, as a result of too rapid a chena cycle. Wood-apple and tamarind, palu and wira, ranawara and eraminiya are common trees, with cactus in between them. Rice and citronella are the chief crops. Apart from two ribbon-like bands in the valleys of the Kirama Oya and Urubokka Oya, the two principal areas under paddy are below Tissamaharama tank and Ridiyagama tank. Citronella is grown mainly in West Giruwa Pattu. In the northern and eastern parts wide stretches of unoccupied country isolate a few scattered villages based on small tanks. In the neighbourhood of the salterns the soil is rather saline, except along the riverine strips, and the main settlements lie away from the coast. Labour for the salterns is therefore difficult to obtain. The scattered fishing settlements found on the coast are connected with the main road by mere cart tracks (see Fig. 86). The fishermen's mud and thatch huts are generally strung out in a line under the shade of a grove of trees. Fresh water is obtained from a well at some distance inland, as the water at the sites of the huts is rather brackish. An open space away from the trees and fully exposed to the burning heat of the sun is used as a dry-fish yard, while between the huts and the sea are beached the boats of the fishermen.

Cotton is cultivated in the East Giruwa and Magam Pattuwas under Government encouragement, and citrus fruits and tomatoes are grown on garden lands. Vegetables and dry grains like kurakkan, amu and meneri are grown in chenas, and plantain and murunga are also grown. There are possibilities in cattle and buffalo rearing which

are being tried out at the State Farm at Ridiyagama, and Ambalantota is noted for its curd. The Ridiyagama farm is the main centre for breeding buffaloes. The population is mainly concentrated in West Giruwa Pattu, where the geographical conditions approximate to those of the wet zone, and thins out rapidly to the east where, away from the colonization schemes, the conditions are more adverse.

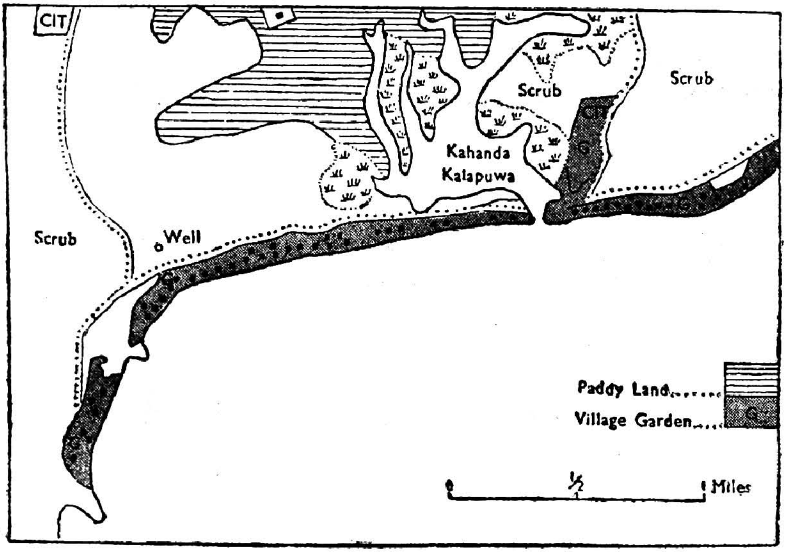


FIG. 86.—S.-E. Coast Fishing Settlement.

Citronella and village gardens, shaded; paddy land, horizontal ruling; dwellings, indicated by square dots.

The increase in population of over 25,000 for the Hambantota District between the censuses of 1931 and 1946 was entirely in the Magam and East Giruwa Pattuwas, and is a measure of the success of the colonization schemes here. The chief towns are Hambantota and Tangalla. Hambantota, the capital and chief town of the District, has always been associated with the salt and fishing industries. It was originally a Moorish settlement, and to this day nearly half

the population (4,300 in 1953) is Malay or Moor. Tangalla is, however, a larger town (6,840 in 1953), and the seat of the judicature.

EXERCISES

1. Describe with examples and sketches the different types of human settlement found in the dry zone.

2. Give an account of the nature and processes of soil erosion occurring in Ceylon. What methods would you suggest to check it?

3. What effect have the soils of the Jaffna Peninsula had on the occupations of its inhabitants?

4. Discuss the extent to which the development of (*a*) irrigation and (*b*) colonization schemes has been responsible for the increase of population in recent years in any *two* districts of the dry zone.

CHAPTER 21

NATURAL REGIONS (*Continued*)

THE REGIONS OF THE HILL-COUNTRY

The Uva Basin is that horse-shoe shaped region of the Central Highlands comprising the upper catchment areas of the Uma, Badullu and Loggal Oyas, which drain northwards into the Dumbara reach of the Mahaweli Ganga. It is the only region of the hill-country with a distinctly dry zone climate, and was probably the first part of the hill-country to be settled by the Sinhalese, as witnessed by the remains of ancient irrigation works, which even involved tunnelling through hills. Its elevation, which varies between 2,000 and 5,000 feet, causes somewhat lower temperatures than in the lowlands, while its configuration shelters it from both monsoons, but more so from the south-west monsoon. The strong winds of the latter, which only reach the basin after losing their moisture, have a very drying effect, and are mainly responsible for the dry patana vegetation, which characterises the region away from the valley bottoms and water courses. The low relative humidity makes the basin an important health resort, especially for those having lung complaints, and Bandarawela and Diyatalawa are favourite health resorts. The downs of Diyatalawa have for the past hundred years been much used for military and survey training camps. The choice of Diyatalawa for this purpose was due to the fact that paddy could not be grown because the elevation was mostly over 4,000 feet, and there were, therefore, few inhabitants. The general configuration and absence of trees also make the area suitable for the manoeuvring of troops and the practice of military opera-

tions. Below 3,500 feet, however, the valley bottoms and hillsides are terraced for paddy, but settlement is sparse

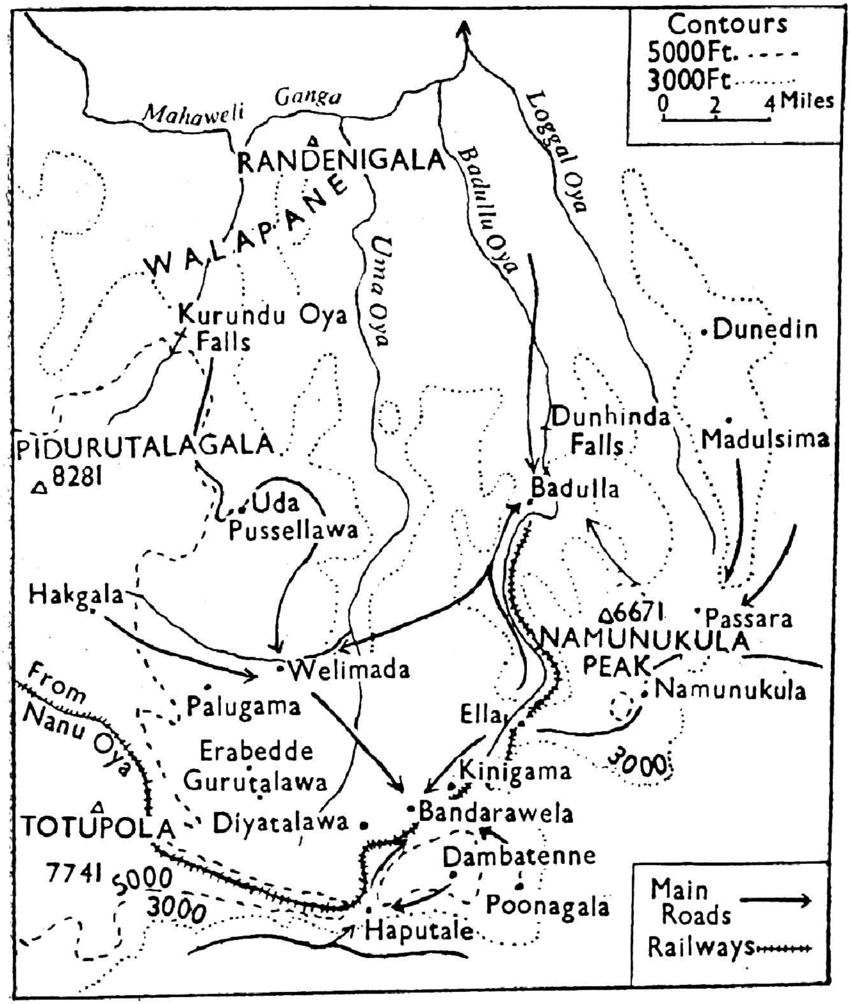


FIG. 87.—The Uva Basin.

as compared with the wet zone. In spite of the dry climate, however, tea cultivation has gradually extended here from the surrounding wet districts of Haputale, Dambatenne and Namunukula. Most of the grass-covered

hills serve merely as poor pasture land for the cattle of the peasantry. Improvement in living conditions can only be effected by the initiation of large scale irrigation schemes, the planting of shelter-belts of Eucalyptus and some scheme of afforestation. The presence of a hard pan some two feet below the surface makes it necessary to hole the dry patanas to this depth before afforestation. The largest afforestation centre has been in the Erabedde dry patanas, where about 1,300 acres have been planted. Experiments carried out at Kinigama near Bandarawela indicate the possibility of growing indigenous trees under a canopy of *Eucalyptus robusta*, which not only increases by its leaf-fall the humus content of the soil, but also by its shade protects the soil from excessive evaporation, and shelters it from the dry S.W. Monsoon winds. Thus favourable conditions predisposing to tree growth are created which cannot exist on bare patana.

Tomatoes, beans and temperate zone vegetables are grown, e.g. at Palugama with the north-east monsoon rains, but during *Yala* these vegetable plots are left fallow. The dry climate is suitable for citrus fruit-growing, provided water supply can be ensured. Some cotton is grown in Walapane.

The only two urban centres are Badulla, the provincial capital, in the north of the basin, and Bandarawela in the south. Badulla occupies a site of some antiquity, and is picturesquely situated in a loop of the Badullu Oya. It serves as the railhead for the surrounding planting districts of Passara, Namunukula and Madulsima. Welimada has a more nodal position in the basin and a healthier climate. Bandarawela serves the Poonagalla and adjoining planting districts.

The Hatton Plateau is the western counterpart of the Uva basin, but has a more complex relief. It has been more deeply dissected into a number of parallel ridges and

valleys, running in the main from south-east to north-west, but with an extension over the northern extremity of the Pidurutalagala-Kondagala-Deltota range to include country

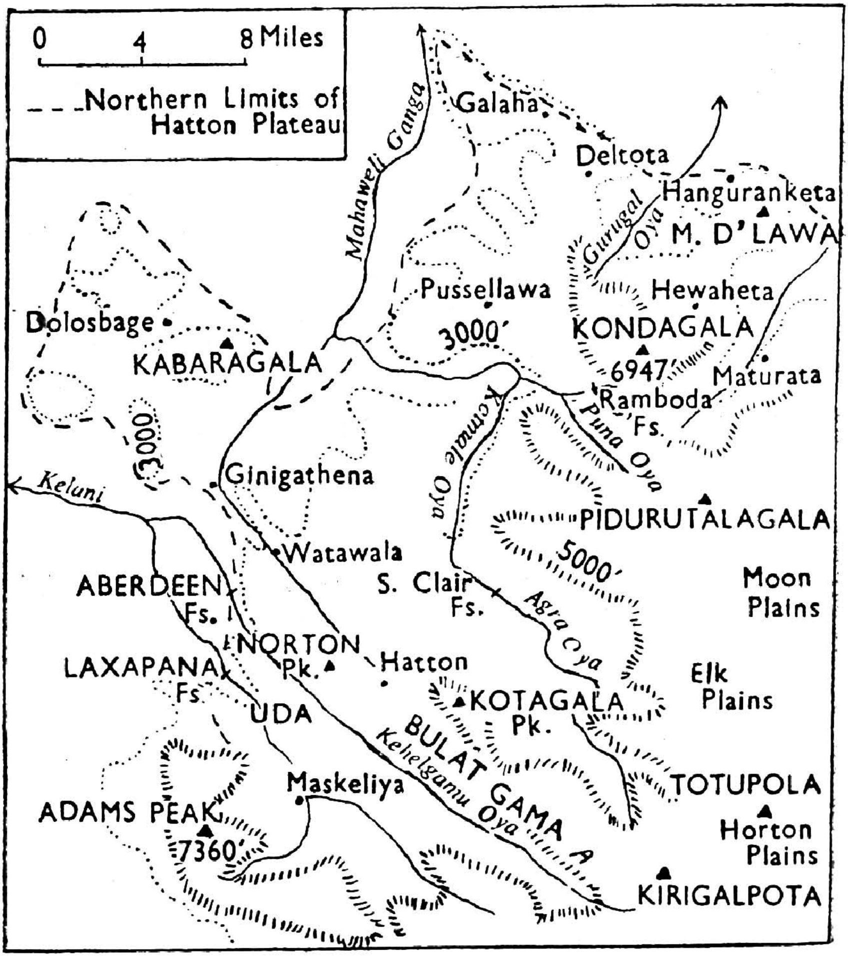


FIG. 88.—The Hatton Plateau.

where the features are aligned from south-west to north-east, as around Hewaheta, Hanguranketa and Maturata. The latter forms one subdivision of the Hatton Plateau. The rest of the Plateau may be subdivided by the ridge connect-

ing the peaks of Kirigalpota, Kotagala and Norton into two parts: (1) a south-westerly section drained by the Maskeliya and Kehelgamu Oyas into the Kelani Ganga, and (2) a north-easterly section drained by the Hatton and Kotmale Oyas into the Mahaweli Ganga. The Dolosbage Hills, which are an extension of the Hatton Plateau across the main stream of the Mahaweli, form a fourth sub-region.

The entire region has a heavy mean annual rainfall, while in the Dolosbage Hills and adjoining parts the rainfall may be described as excessive, with a tendency to a single south-west monsoon maximum, and a distinctly drier period from January to March. On the Hewaheta—Maturata side, however, the regime is definitely that of the north-east monsoon with a January maximum, and at Maturata, June, July and August are really dry. Temperatures throughout the region are quite pleasant, and average about 70°F.

The numerous waterfalls testify to ample resources of water power, but so far only the upper streams of the Kelani Ganga have been tapped by the power station at Laksapana. The region was once entirely covered with an evergreen forest which, though it yielded few trees of value for timber, nevertheless preserved the steep slopes of the hillsides from erosion. First cleared for the planting of coffee in the 1840s, and subsequently on a more extensive scale for tea, nothing of the original forest now remains, except above elevations of 5,000 feet. The region is virtually under the complete dominance of the tea industry—it is indeed Ceylon's tea-garden *par excellence*. Only the lower valley bottoms below 3,000 feet continue under paddy. These are mainly north of the latitude of Watawala. Near Watawala and Ginigathena some land is under rubber. The Dolosbage Hills, though not reaching 5,000 feet, (Kabaragala, 4,944 feet) have several patches of forest. Apart

from tea, cardamoms are also cultivated here, and the lower slopes are under rubber. There is also some coffee.

Many of the hills are patana-covered, particularly on the Deltota-Hewaheta side. Other crops are cardamoms, tobacco and cinchona. As tea requires a great deal of labour, the population of the whole region is fairly dense, but it is mainly a population of immigrant Indian Tamils, at least in the Nuwara Eliya District and in Uda Bulatgama. In other parts, however, Sinhalese form the majority and are gradually replacing Indian labour. Most of the towns are tea planting centres, e.g. Hatton, Maskeliya, Hewaheta. Communications with the low-country are through the Ginigathena gap, or *via* the Kandy Plateau and Kadugannawa gap.

The Piduru Ridges and High Plains.—The Piduru ranges are those which radiate northwards from Pidurutalagala, and serve to isolate the sub-regions of the Hatton Plateau. The main range runs N.N.W. through the peak of Kondagala in the direction of Kandy, with a branch to the west known as the Great Western Range. Between the two lies the valley of the Puna Oya, which gives the most direct approach to Nuwara Eliya from Kandy. On the eastern side one spur from the main range runs to the peak of Meeriatenne Diyatalawa, which towers above Hanguranketa, while the other runs south of Maturata north-east to Randenigala. These are, however, only the outposts of a region, the main portion of which is constituted by the plateau-like stretch that connects Pidurutalagala with Totupola and the Horton Plains.

Climatically, this is the coolest part of the Island, and apart from the Nuwara Eliya basin, contains a number of level stretches, such as Kandapola, Moon Plains, Elk Plains and Horton Plains. It was quite uninhabited till British times, when an English officer who was out hunting reached this elliptical mountain valley quite accidentally

in 1826, and realising its potentialities as a health resort for Europeans, reported his discovery to the Governor, Sir Edward Barnes. The latter promptly had a road constructed to the spot, in order to use it as a sanatorium for himself and other British civil servants, who needed some temporary respite from the enervating heat of the plains. Nuwara Eliya is now the most popular holiday resort of the Island, and its attractions are becoming in-

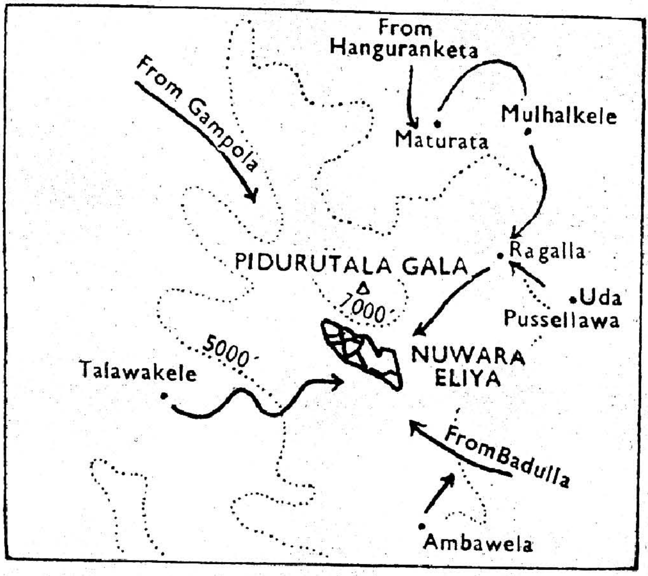


FIG. 89.—The position of Nuwara Eliya.

creasingly known to rich people from abroad, who wish to escape the rigours of winter in northern latitudes. Temperatures average 60° F., with occasional frosts at night in December-February. Nestling at the foot of Ceylon's highest mountain, Nuwara Eliya lies at the intersection of two important mountain roads: (1) that from Gampola to Badulla *via* the Ramboda Pass, and (2) that from Talawakele and the Kotmale Oya valley to Kandapola and Uda Pussellawa. Plantations spread rapidly into the basin till

1873, when the danger of reckless clearing was first realised, and legislation passed to prevent further alienation of land above 5,000 feet. Most of Ceylon's highest-grown tea is raised around Nuwara Eliya and Kandapola. Many of the high ridges, however, still retain their forest cover, while many parts seem to have been long under patana, (see p. 74).

The possibility of using the wet patana lands for dairy farming with English breeds of cattle is being tried out in the Government farms at Bopatalawa and Ambawela. The Bopatalawa cattle farm is situated at an elevation of 5,000 feet in the basin of the Agra Oya. It has an extent of 4,350 acres, and rears European breeds of cattle, such as Friesians, Shorthorns, Jerseys and Red Polls. The production of milk is well over 2,000 pints per day. The smaller Ambawela farm rears Ayrshire cattle. Daily milk production is over 1,000 pints. At both farms pig-rearing is also carried on.

At the foot of the Hakgala Rock nestle the famous gardens, where experiments with the acclimatization of plants of the temperate zone are carried out. Growing of temperate zone vegetables is important in some places, e.g. Kandapola and at Padinawala at the foot of Hakgala. Wide tracts are still uninhabited.

The Adam's Peak Range and Southern Mountain Wall have the rugged characteristics of the Piduru Ridges on a more intensified scale, but with hardly any plateau features. (See also p. 20.) They are really in the nature of a divide rather than of a zone, and are too steep to be crossed by roads, except where they lower to the Haputale gap. Except near Haputale it is really wild country, covered by thick forests, e.g. the Peak wilderness, which if cleared would cause much damage through soil erosion under the torrential rains, particularly in the west. In the east, where the rainfall is not so intense, some of the slopes have been cleared for tea, as at Dambatenne and Poonagalla.

Here the flattened summits of S. Catherine's and Bandara Eliya recall the features of the High Plains on a smaller scale. Beyond the valley of the upper Kirindi Oya, which gives an approach to Ella not yet followed by a road, are the Namunukula Hills, which too are clothed with tea plantation and forest. We may include in this region the Madulsima range, which is separated from it by the Passara Gap. The road from Passara scales this ridge and runs along its crest at an altitude of 4,500 feet to the tea estates of Madulsima, Dunedin and Roeberry. The town of Passara is the eastern gateway of the Uva Basin. It serves as a focal point, not only for the routes from Namunukula and Madulsima, but also for the tea and rubber of the Lunugala Badalkumbura platform. It has been recently connected by a direct road with Moneragala *via* Nakkala.

The Kandy Plateau lies at an average elevation of 1,500 feet, and is that part of the first terrace of the Central Highlands drained by the Mahaweli Ganga and its tributaries in its course from Nawalapitiya to Rantembe. Containing the old Sinhalese capitals of Gangasiripura (Gampola) and Maha Nuwara (Kandy) and lying in the direct line of approach from the ancient Raja Rata through the Matale valley, this region has always been the most densely settled and best developed part of the hill country. It is shut in on the south by the hills of Dolosbage and the Pussellawa and Galaha spurs of the Hatton Plateau, and on the north and north-east by the Matale Hills and the Knuckles. On the west it overlooks the ridge and valley region of Sabaragamuwa in a mural scarp scaled by the passes of Kadugannawa and Galagedara. Above the general level of the plateau rise a number of steep ridges of higher ground, e.g. Gannoruwa-Yahalatenne, Udawattekele, Ampitiya-Merayaka, and Hantane.

Temperatures, while not so cool as on the Hatton Plateau, are much more endurable than on the lowlands.

The annual rainfall averages about 85 inches, and is generally well distributed, but south of the confluence of

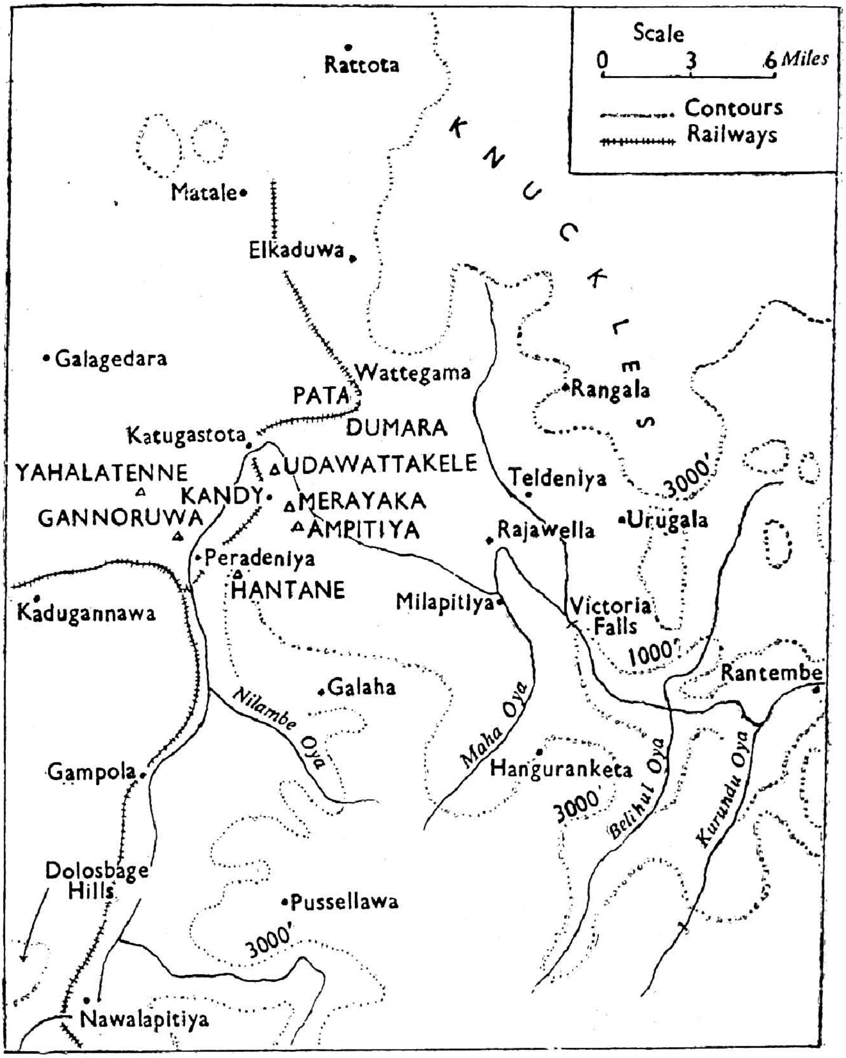


FIG. 90.—The Kandy Plateau.

the Nilambe Oya, it increases to over 100 inches, while the Milapitiya-Rajawella rain-shadow has less than 75″. The

region appears to benefit from both monsoons, and also from the cyclonic depressions of November.

Very little land is uncultivated, except to the east of Milapitiya, but even here much of the vegetation is scrub and patana, and only a few patches of forest remain. Being a region where both low-country and up-country crops can be raised, it has a rich and varied agriculture. The alluvial valley floors are devoted to paddy and the terracing of the hillsides for its cultivation has been carried to a high pitch of perfection. Coconut, jak and other fruit trees are grown on land that cannot be asweddumized. The peasants, though at first dismayed by the development of the plantations on what used to be their chena lands, soon took to raising cash crops, such as pepper, tobacco, kapok and coffee, and now also grow tea, rubber and cacao in small holdings. The last three are the main crops of the plantations, the special region for cacao being the sheltered valleys of Pata Dumbara and Matale South. Coconut estates are found mostly in the main valley of the Mahaweli Ganga between Kandy and Milapitiya. Small villages are scattered throughout the region, while isolated planters' bungalows are found on the hilltops. The houses in a village are strung out along the edge of the paddy land as shown in Fig. 91. The larger villages and chief towns lie, however, in the main valley and along the chief arterial

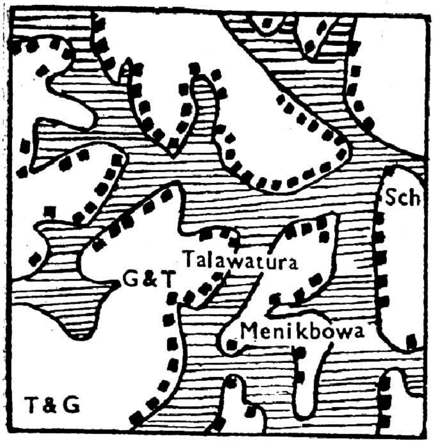


FIG. 91.—Distribution of dwellings above valley floor paddy lands (horizontal ruling) in the Kandy Plateau.

roads that lead out from Kandy, the largest town of the hill-country and the capital of the Central Province. Kandy owes its importance mainly to its command of routes and its historical and national associations. It was chosen as the Sinhalese capital at the end of the sixteenth century, partly owing to its command of routes, and partly owing to its strong position which was capable of easy defence. It lies within the northern bend of the Mahaweli Ganga in a picturesque basin surrounded by hills. Its choice as a lucky spot for the site of the Dalada Maligawa to enshrine the sacred Tooth Relic, and the later institution of the Perahera created associations of national tradition, which have not only made it a centre of pilgrimage, but a source of attraction to tourists as well. It is

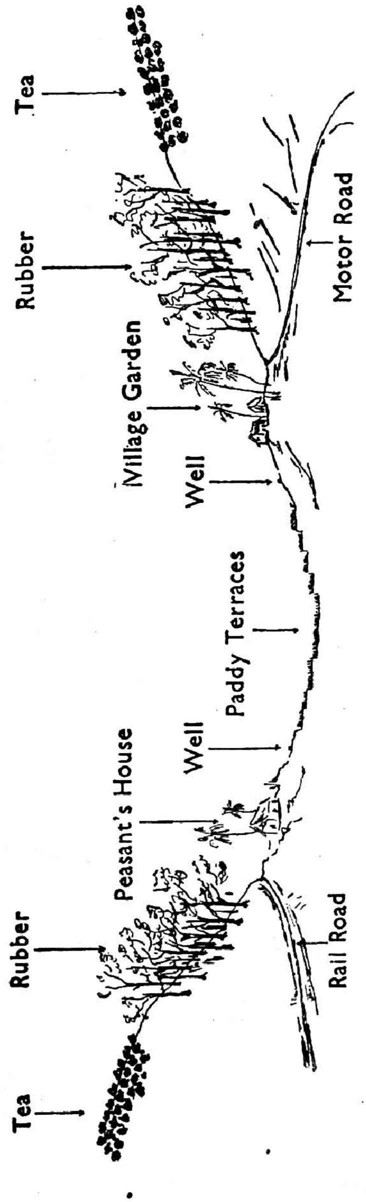


FIG. 92.—Diagrammatic section showing land utilisation in a valley of the Kandy Plateau between Peradeniya and Gampola.

also noted for its brass and silver work, and ancient arts and crafts. The limits of the town extend from Katugastota in the north to Peradeniya in the south. Of its population of 57,359 at the Census of 1953, as many as 19,843 were Low-Country Sinhalese, who outnumbered the Kandyan Sinhalese by nearly 3,000. The fact that Kandyans are in a minority in the other large towns of the region too, shows that the Kandyans were not so ready to follow such new avenues of employment as the work of contractors, trans-

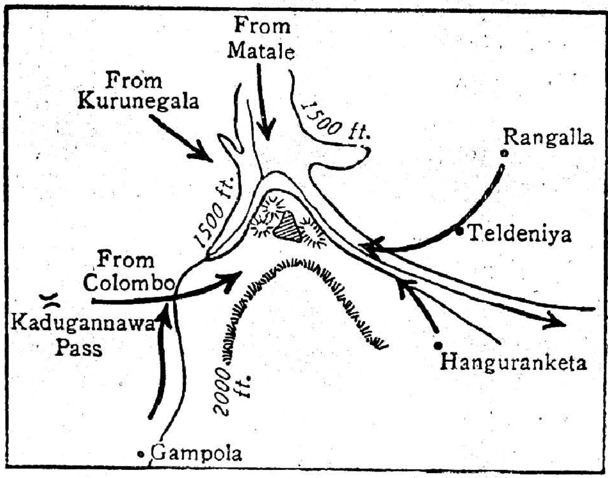


FIG. 93.—The Position of Kandy.

port agents and traders offered them by the rapid development of the plantations. The building of the new University of Ceylon in what is virtually a suburb of the Hill Capital will increase still more the size and importance of Kandy.

Matale, near the northern end of the plateau, is the second largest town, and is an old trading centre on the ancient route from the populous northern lowlands to the retreats of the hills *via* Dambulla and the Naula-Nalanda gate. Gampola and Nawalapitiya are the chief towns in the south. The former had an important strategic position, and is centrally situated with reference to three passes—

Kadugannawa, Ginigathena and Ramboda. It commands the routes leading from the Kandy Plateau to the Hatton Plateau. With the development of the plantations it became a collecting centre for the Dolosbage region to the west and the Pussellawa region to the east. Gampola is also directly connected by road with Kadugannawa—a link which is becoming increasingly more important. It has thus become the starting point of many motor bus services. Its commercial importance may be gauged by the fact that Ceylon Moors constitute a majority of its population. Though the productivity of the alluvial deposits that made the Gampola valley an important granary of the hill country may have been a factor in its choice as an ancient capital, nevertheless its low-lying situation makes it liable to flood—a disadvantage from which it has increasingly suffered in recent years. After the phenomenal floods of 1947, a housing scheme for refugees was provided at Mariawatte, and the need for moving the town to higher ground was considered.

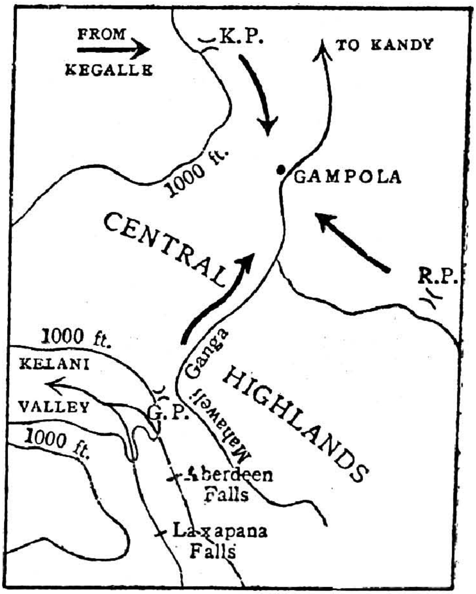


FIG. 94.—The Position of Gampola.

The Balangoda and Koslanda Plateaus are the southern counterpart of the Kandy Plateau. To the west of Balangoda the plateau rises to over 4,500 feet in the Petiyagala-Kabaragala ridge, but the rest of the region is

undulating plateau of the same height as the Kandy Plateau, but not of the same density of settlement. North of this ridge the valleys of the upper Walawe Ganga and Bambarabotuwa Oya form a line of denser settlement and provide an alternative route to Ratnapura, but the main routeway of the plateau runs from the Kelani Valley railhead of Opanaike to Balangoda and Koslanda. Around these two places there is a good deal of land under rubber and more under tea, but elsewhere the population is sparse, much land is under forest and chena, and the region is somewhat cut off from the lowlands by the steepness of the plateau scarp and the undeveloped nature of the plains to the south-east. There are also many areas of savannah and park country, while many of the jungle clearings are occupied by a secondary growth of fern (*kekilla*).

The Rakwana-Deniyaya Massif is separated from the Balangoda Plateau by the Wey Ganga and the Rakwana Ganga, but the Kiribatgala ridge north of Watapota and the Galkanda-Suwandekekunahena hills north of Godakewala serve to indicate the connection. Its average elevation is somewhat higher, and much land is under rubber and tea, the chief centres being Rakwana in the north and Deniyaya in the south. Many hilltops are patana covered, but the largest reserves of the great Sinharaja Forest cover the hills to the west and north-west of Deniyaya. There are a few areas of flat country, such as the plains of Tangamale and Handapan Ella, at elevations of 3,500 and 4,000 feet. At these elevations cardamoms as well as tea are grown. The Rakwana Plateau has been a formidable barrier to communications, and it was only in 1941, with the completion of the Hayes-Lauderdale road that a complete routeway across it was provided *via* the Bulutota Pass.

The Knuckles Hills Region is roughly defined by the 3,000-foot contour, and consists of all the country to the north-east of the Kandy Plateau of a sufficient height to

differentiate it from the latter in both temperature and rainfall. The crests of the Knuckles ridge form an important climatic divide separating two well contrasted sub-regions—the north-eastern and south-western. The eastern slopes of the Knuckles benefit from the N.-E. Monsoon, and have a heavy rainfall probably approaching 200 inches per annum, but the region has not been developed,

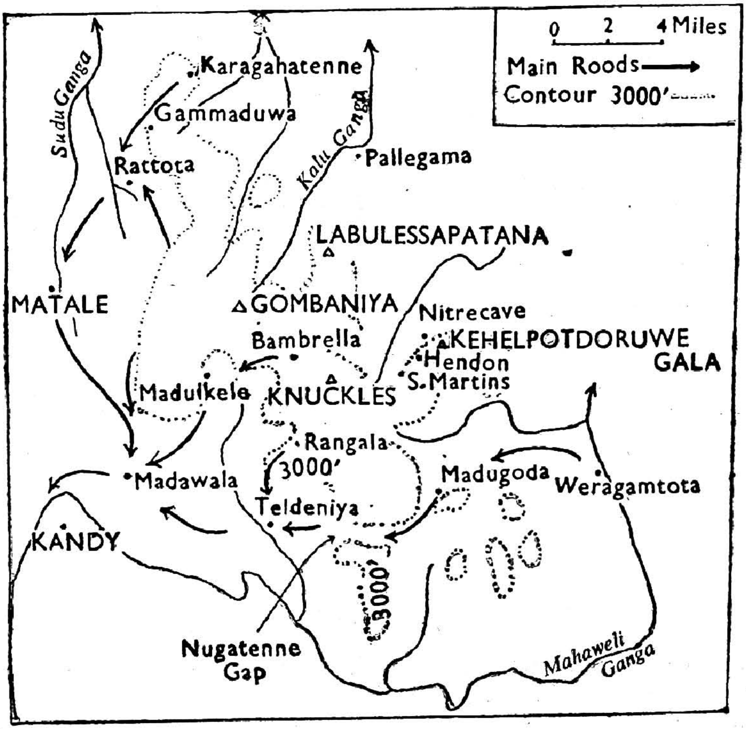


FIG. 95.—The Knuckles Region.

because of the difficulty of access. The region forms very rugged desolate country, covered with scrub, jungle or forest, and dominated by rock masses like Labulessapatana, 4,009 feet, and Kehelpotdoruwegala, 5,016 feet. The region is deeply dissected by numerous streams, which in the north

reach down to below 1,500 feet, and whose valley bottoms occasionally sustain slender ribbons of paddy cultivation. Around S. Martin's and Hendon there is a certain amount of tea and cardamom cultivation, but many of the estates have been abandoned. There are no roads; only footpaths and cart tracks. In the valley of the upper Kalu Ganga, which flows past Pallegama to join the Amban Ganga, are several abandoned coffee estates.

A spot of peculiar interest in the region is Nitre Cave, a huge cavern inhabited by large numbers of bats, whose droppings, accumulated through the ages, have formed a deposit on the floor of the cave.

The western side is less rainy, but has been extensively brought under tea cultivation, e.g. at Rangalla, Madulkelle, Bambrella and Gammaduwa. Here and there the tea is interrupted by extensive patches of cardamoms, which in most cases are owned by the tea estates. Unlike the north-eastern slope this region is well served by roads, but these do not traverse the crest, being mere culs-de-sac leading only up to the estates they serve. Only one road traverses the region completely, and that at the southern end. It connects Kandy and Weragamtota *via* Teldeniya and the Nugatenne Gap.

EXERCISES

1. Divide the Mahaweli basin above Minipe into natural regions and justify your division.

2. Compare and contrast the methods of agriculture in the Jaffna Peninsula and Hatton Plateau.

3. With the help of detailed sketches examine the factors which have favoured the development of the following towns:—Kandy, Nuwara Eliya, Gampola, Badulla.

4. Draw sketches to illustrate the types of rural settlement found in Ceylon.

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